AMERICAN VETERINARY REVIEW,

MAY, 1889.

EDITORIAL.

UNITED STATES VETERINARY MEDICAL ASSOCIATION.—Our relations—the objects of each—creating and sustaining a truly Americanized veterinary profession—the progress of American veterinary literature—the works and the efforts of the REVIEW—our hospitality—gathering of good material at the semi-annual meeting—The Massachusetts Veterinary Medical Association—Œtiology of Tuberculosis by Koch, from the transactions of the Massachusetts Veterinary Medical Association—our publication of this valuable paper—also of the comptes rendus from Dr. Hoskins—also of other papers. POLITICAL GUILLOTINE ON VETERINARIANS.—One more convincing evidence of the progress of veterinary science in the United States—the veterinarian has had all he could wish—now the official guillotine works on him—his sudden collapse from official position to sad realization of political unimportance—it is not surprising to us—but why apply it to scientific specialists—Dr. Billing's resignation the result of political influence. SACRIFICED TO PROFESSIONAL DUTY.—Terribly sad news relating to Dr. P. Paquin—he is reported suffering with glanders—our hopes that we soon will have to report this as an error of diagnosis—our best wishes for his recovery. COMPLAINTS.—The REVIEW does not come regularly—who is at fault—a mean to correct the evil—let us try it.

UNITED STATES VETERINARY MEDICAL ASSOCIATION.—We have never failed to acknowledge our relation to the United States Veterinary Medical Association, and among the reasons by which we have been influenced in this, one has been the conviction, which we have always entertained, that the Association is to be regarded as the accepted representative of the profession in the United States, and whatever may be their course, and whatever the labors and transactions might be in which they may be engaged, the intent and the result will always prove the

identification of the organization with the interests, the progress and the improvement and elevation of American veterinary science.

We have sometimes, of course, found occasion to animadvert upon some of the proceedings and positions of the Association, and have at times criticised them quite sharply for an apparent lethargy of movement. But if we have been guilty in this respect, we have, on the other hand, never neglected the opportunities which have presented themselves to do them justice, and to work with them harmoniously for the same common object, viz: *Creating and sustaining a truly Americanized veterinary profession*, in whatever comprehensive national sense the phrase may be interpreted. The progress of American veterinary literature has probably been more laggard than that of any of the departments or interests pertaining to our peculiar guild, although the importance of a thorough cultivation of this department of our science is too obvious to call for argument or illustration. If for example, the essays, clinical reports and other professional papers of, say the last score of years, were collected and collated, how poor a show would it all make! The REVIEW, within its limited sphere, labors to the extent of its power to bring about and maintain a better state of things in this respect, and we are always glad to take advantage of the occasions which are offered by the meetings of such of our veterinary societies as can be reached and made available in this behalf. One and all, moreover, the army of private veterinary practitioners of the country, are made more than welcome to our columns whenever they may choose to communicate in public with their brethren, upon any subject of genuine and general interest to the professional community. Our readers can judge for themselves as to the extent to which the hospitality of our columns has been thus far accepted.

The semi-annual meeting of the National Association which occurred in March last, proved to be one amongst many of the richest we ever attended, in the material of its composition and the value of its results, and the pleasure experienced by us on that very agreeable trip is one of the reminiscences with which our memory will not lightly part. We were fortunate enough

on this occasion to obtain from the Massachusetts Veterinary Medical Association the manuscript of the translation of that most excellent work of the great German pathologist, Koch, on the Ætiology of Tuberculosis, and our readers will be glad to know that we intend in the present and two following numbers of the REVIEW to publish the entire work. Our warm acknowledgments are due for the kindness of Dr. Winchester and the Massachusetts Association for thus enabling the REVIEW to present to its readers the first and only English translation of the most complete work on this important subject. The opportunity is one which should be fully appreciated, and of which we hope our friends will readily take advantage. Besides this, our present number will give the *compte rendus* which Dr. Hoskins had kindly forwarded to us, but which failed to come into our hands in time for our April number. In addition to these, two other of the papers which were read at the March meeting will be found in our present issue.

POLITICAL GUILLOTINE ON VETERINARIANS.—Among the most convincing of the evidences which tend to prove the diffusion of a better knowledge and higher appreciation of the importance which has been acquired by the cause of veterinary science in the past five or six years, there is, in our estimation, (as an observer of foreign birth), none so prominent and conclusive as that which offers itself in the recent changes which have either occurred already or are destined to be accomplished in the establishment of a recognized official position for members of the veterinary profession. It is indeed a fact, that there is at length an established relation between politics and veterinary medicine, and what can the veterinarian of to-day ask now? Yes, the veterinarian has become subject to specific laws for the regulation of his profession; he has State legislation to protect his name and his title; State appropriations for veterinary purposes, with State and city appointments of official scientists to carry them into effect, and the civil service law has interposed and offered him its sanctions and precautions and means of advancement and of promotion. Is it then surprising that, like all other official appointees, he should now be exposed to the same official

guillotine, and share with other officials the common and universal liability to discover some day that he has suffered the process of capillary amputation? To-day he may be a meat inspector, a city Board of Health appointee, a State veterinarian, a chief or a simple officer of the Bureau of Animal Industry, but sometime an election has been held and he walks forth with his official head in his hand. He has been guillotined, and only his private personal caput as a veterinarian remains on his shoulders to illustrate and comprehend the chances of official life. He has leisure now to search for the reason of this sudden revolution in his condition, but the only discovery that rewards his reflections is that his professional claims and abilities were not strong enough to overcome the political "pull" of some other man whose "services at the primaries" have been of more value than his to the man who has been elected.

Well, after all there is nothing very peculiar about this—it is "politics" merely—we had no right to expect things to be otherwise; we did, personally, know of it, but we never dreamed it would go quite so far as it seems to have been carried in some quarters, and certainly we never had entertained the idea that professorships could be cast aside, and competent and hard-working public servants compelled to resign their positions after accomplishing large labors for the common good, and all through the operation of political influence.

We certainly cannot pass over the resignation of Professor Billings, of the University of Nebraska, which, if we are correctly informed, was brought on through the stress of political motion, without a word of protest and without regretting our modest position in a post where no "*executeur des hautes œuvres*" could be found to deprive us or any of our confreres of our heads, solely because of political power or as a punishment for a difference in political opinion. In our capacity of veterinarians, it seems to us to be a matter of little importance whether we are known as a member of one party or another, or whether the Democratic or Republican platform best expresses our political sentiments. Let the men who do their work well and to the best of their ability be respected for their works' sake, without impertinent interfer-

ence, so long as they contribute their aid to the common great object of working in behalf of the animal wealth of our country.

Sacrificed to Professional Duty.—An item of news of a most afflictive kind has reached us, which, though we reluctantly record it, we cannot avoid hoping most sincerely may prove to have been exaggerated beyond the fact, and that we may soon have the satisfaction of correcting it. It is to the effect that Dr. Paul Paquin, the young State Veterinarian of Missouri, and who has for some time been making himself favorably known to his professional brethren by his scientific work, and a series of interesting investigations, has written to inform us that he has been attacked with an illness of the most alarming kind, and that he himself, as well as his physician in attendance, have been compelled to admit the conviction that he is doomed to close his mortal career as a victim to the fatal infection of glanders. The doctor, who, we believe, has moved for treatment to the Hot Springs of Arkansas, seems to be nearly certain of his diagnosis, and that, to us who know the prognosis in such a case, has a fearful meaning. Let us hope that in the account which we have received, we may be justified in ignoring the process of inoculation ascribed as the cause of the blood poisoning, and that we may at an early date be authorized to an nounce that the veterinary profession is not yet to be called to lament the death of our young compeer as a martyr to his professional duties.

Complaints.—We have received several letters complaining bitterly of the irregular delivery of the Review. We have in all cases carefully inquired into the causes of the irregularity, and of course, as usual in similar cases, have failed to discover the true cause. We are not to blame ourselves, of course, nor are the post-office agents! "Can we remedy the evil?" is the question. We believe that if our friends, one and all, would write plainly on a postal card, their full name, full address, street and number, and when possible, post-office number when there is one, a great deal of this trouble would be avoided. Let us try it.

ÆTIOLOGY OF TUBERCULOSIS.

By Dr. R. Koch, Privy Councillor.

(Translated by Rev. F. Sause.)

(*Transactions of the Massachusetts Veterinary Medical Association.*)

A series of investigations of the Ætiology of Tuberculosis which I have been making within the last few years have led me to results which were first reported before the Physiological Society of Berlin, March 24th, 1882 (Berliner klinische Wochenschrift, 1882, No. 15). My communications at that time, however, could only embrace the most important points, while the more minute description of the attempts was necessarily reserved for a detailed report. Since then, by continued investigations, many gaps have been filled and new matter added. The report of my labors in the investigation of the ætiology of tuberculosis, completed and enlarged by these researches, is given in the following.

The question whether tuberculosis is a disease dependent upon transmitted disease-germs can be approached in different ways, as this has in fact been done. It has been attempted to secure certainty, partly with the aid of clinical observations, partly by means of anatomical and also by experimental investigations. Most uncertain are the results of the experience gathered at the sickbed. It is true, cases occur in the experience of every physician with fair practice, in which he cannot fail to see a transmission of tuberculosis from one person to another. Then, however, follow numerous cases in which every possibility of infection seems to be excluded. Attempts have been made repeatedly to prove the contagious nature of phthisis, but they must be looked upon as failures, as such views have never found acceptance among scientists. Some clinical authorities, to be sure, have not lost view of the possibility of contagion, but on the whole physicians consider phthisis a non-contagious disease, proceeding from constitutional anomalies. An indication of the infectious character of tuberculosis, which cannot be ignored, was given by pathological anatomy, when Buhl called attention to the connection of miliary tuberculosis with käse-herden,* (a German technical term of which I do not know the meaning in the English language) and offered the proposition that general tuberculosis is to be looked upon as a disease which is brought about by the resorption of a virus present in the primary käse-herd (cheesy-nodule), hence as it were, by auto-infection. As to the manner in which tuberculous virus spreads itself through the body, the discoveries of Ponfick in regard to the thoracic duct and of Weigert in regard to veinous tubercles in miliary tuberculosis have given light. However, these facts only prove the spread of tuberculous virus in the body itself, without proving the transmission from one individual to another, in which latter the contagious nature really consists. With this last question experimental pathology has occupied itself in the most searching manner. The course taken in experimental investigations of the infectious nature of tuberculosis has been described of late very minutely, (cf, Johne, Die Geschichte der Tuberculose. Leipzig, 1883), so that I can omit the historical details and confine myself to a few remarks on the more inportant heads.

*Cheesy nodules.—S.

Solitary, incomplete and negative attempts to generate tuberculosis artificially were made towards the end of the last century. The first successful attempts were made by Klencke, who by inoculation of miliary and infiltrated tubercles from the human being into the cervical veins of rabbits, brought about a widespread tuberculosis of the lungs and liver. Klencke must therefore be pronounced the discoverer of experimental tuberculosis. He did not continue his attempts, and so they were almost forgotten. In a systematic and thorough manner experimental tuberculosis was worked out by Villemin. He not only inoculated tuberculous substances from the human subject, but also from the pearl disease of cattle, and showed by experiment the identity of pearl disease and tuberculosis. Villemin's investigations seemed already, by the number of experiments, by their careful execution and comparison with opposing attempts bearing upon the same question, to have decided the question in favor of the infection theory. Nevertheless the numerous investigators who repeated Villemin's attempts according to the methods suggested by him or in modified ways, arrived at very contradictory results. The defenders of the infection theory, especially Klebs, sought to improve the experimental technique and to free it from the errors clinging to it; the opponents, on the contrary, strove to prove that the tuberculous substance possessed no virulent properties, and true tuberculosis could be produced by inoculation with material in which tuberculosis did not exist. This dispute was first settled by the experiments of Cohnheim and Salomonsen who, with this end in view, inoculated the anterior chamber of the eyes of rabbits. It was an exceedingly happy idea to make use of the rabbit eye as the place of inoculation. From the nature of the case, those cases in which tuberculous substance only has been inoculated must be distinguished from those in which other infectious material has been combined with the tuberculous virus. In subcutaneous inoculation, such materials often produce more or less widespread caseous infiltrations, which are not unlike the tuberculous cheesy products. In the eye, on the contrary, they cause an inflammation which rapidly runs its course, which can in no case be mistaken for the inoculated tuberculosis, which is slow and unique in its development. This inoculated tuberculosis, when the experiment is successful, takes such a course that it is always manifest to the investigator. After a somewhat prolonged stage of incubation little gray nodules appear in the iris, scarcely visible to the naked eye and proceeding from the transplanted portions of tuberculous substance. The number of these nodules increases gradually, they themselves grow, become yellowish in the center, become cheesy and show as well macroscopically as microscopically all the typical characteristics of genuine tuberculous nodules.

Tuberculous infection is, moreover, not confined to the eye, but spreads itself later through the entire organism; it attacks especially the neighboring lymphatic glands, the lungs, spleen, liver and kidneys. According to the united testimony of Cohnheim and Salomonsen and all other experimenters, who have repeated these attempts, an iris-tuberculosis has in no case followed the inoculation with non-tuberculous substances. More than this, a spontaneous case of iris-tuberculosis in rabbits has never been observed. This method of infection is therefore superior to all others in so far as that the influence of unintentional errors in attempt is shut out, errors which so easily creep into the experiments in subcutaneous inoculation and in transplantation into the abdominal cavity. The chance of

mistaking artificial tuberculosis for that arising spontaneously is also completely excluded. Therefore in comparing the attempts of Cohnheim and Salomonsen with those previously made, they must be admitted to be completely free from objection, and by them it is proved that the most different tuberculous substances contain a specific and individual element.

Of what character this infectious matter might be, whether it be formed by means of organisms independent, or provided with unvarying properties, which force themselves into the body as parasites and communicate tuberculosis to it, or whether the infectious material exists only in certain conditions of the body and consists of organized or unorganized formations arising from its own ingredients, was a question that for the time being could not be decided. But after the results, which have been attained of late years regarding the ætiology of many infectious diseases, the possibility that also the cause of tuberculosis was to be sought in some sort of micro-organisms, seems to be indicated. In order to obtain light on this point, it was necessary to make use of all that experience which had proved itself useful in the examination of other infectious diseases, and the same course of investigation was to be chosen which in other cases had shown itself most to the purpose. To make the best use of these advantages, the attempts were to be made in the following manner: In the first place, it must be decided whether form elements, not belonging to the elements of the body, or arising from them, are present in the diseased parts. If the existence of such can be proved, then we must investigate whether the same be organized and whether they offer any signs of independent life, among which independent motion, (for which molecular motion is very often mistaken), growth, increase and generation are to be reckoned. Further, the relations to their surroundings, the conduct of the components of the neighboring textures, their diffusion in the body, their appearance at the various stages of the disease, and other circumstances must be traced, which, with more or less probability, show a primary connection between these formations and the disease. It is possible that the facts gained in this manner may afford such proof that only the most extreme scepticism can maintain that micro-organisms found are no cause, but only an accompaniment of the disease. Often, of course, this objection is justified, and therefore it is necessary for a complete system of proof that one should not confine himself to showing the co-existence of the disease and parasites, but that, more than this, these parasites must be shown to be the real cause of the disease. This can only be done by removing the parasites from the diseased organism completely, and freeing them from all products of the disease to which a hurtful influence could be ascribed, and that by the introduction of the isolated parasites into the healthy organism, the disease with all its peculiar characteristics should be produced anew. An example may serve to explain what has just been said. If the blood of animals which have died from inflammation of the spleen be examined, there are always found therein numerous minute, rod-shaped, colorless, motionless forms. One could not see immediately that these minute rods are of a vegetable nature, and indeed in the beginning they were often held for lifeless crystalline bodies. First from the circumstance that they were seen to grow from spores, and that from the spores little rods were developed anew, could it be decided with certainty that they possessed life and belonged to the lowest class of plants. Further,

when the very smallest amount of the blood of an animal dying of inflammation of the spleen is inoculated into another animal, said animal invariably dies of the same disease, and it also contains the little rods, the so-called "bacilli" of inflammation of the spleen. This does not prove, however, that by the inoculation of the little wands, the disease was communicated. In order to know whether the bacilli, and not other components of the blood of inflammation of the spleen, produces said inflammation, the bacilli must be separated from the blood, and be inoculated alone.

The isolation of the bacilli can be ascertained with most certainty by continued cultivation apart from all other things. To this end, a small quantity of blood containing bacilli is placed upon some fixed nutrient soil, on which the bacilli are able to grow, for instance, nutrient gelatine or boiled potatoes. Here they soon begin to increase very rapidly, while the other components of the blood, corpuscles and serum, remain unchanged. After two or three days, when the bacilli have formed a dense mass of spore-holding threads, the smallest possible of the no longer blood-red, but whitish looking mass, is taken and again placed upon nutrient gelatine or boiled potatoes. The bacilli increase in exactly the same manner as in the first planting, and form a dense white mass on the potato, and already in this second transplanting the most careful examination with the microscope will scarcely show any traces of the other components of the blood. In like manner the continued transplanting is carried on. After the third or fourth, the bacilli may be considered free from all other parts of the blood, which at first were planted with them. If the transplantations now are repeated twenty or fifty times, or still oftener, then it may be concluded with all imaginable certainty, that not the least taint of the disease clings to the bacilli. Even internally they could hide nothing of that kind; for the finest planted bacilli are also no longer present, and their descendants for many generations have obtained the necessary material for their growth from their fostering soil, the potato. The pure breed obtained in this way has no connection with the diseased organism from whose blood the first planting came, and with the products of disease, which belong to animal metamorphosis. Nevertheless, as soon as they are inoculated into a healthy animal, they produce the fatal disease. The inoculated animal sickens as quickly and with the same symptoms as if it had been inoculated with blood fresh from a diseased animal, or had spontaneously become diseased with inflammation of the spleen, and in its blood appear the same innumerable bacilli as in the natural disease, which have the same properties as the well known bacilli of inflammation of the spleen. In view of these facts, there is no other explanation, than that said bacilli are not an accompaniment of inflammation of the spleen, but the real cause of this disease. Now inflammation of the spleen does not always present the same clinical appearance; its form varies in the different species of animals; in the case of man it can run its course with the symptoms of a general infection, without prominent local disturbances, or it can remain purely local and confine itself to a certain point on the outer skin, on the gut, or on the larynx. Nevertheless also in these cases, if the characteristic bacilli are found in the diseased places, we must consider them as the cause of the disease; for their disease-producing qualities are known to us, and we cannot very well imagine that in the tissues of the same organism the

bacilli are at one time harmless, at another time disease-producing parasites. These conclusions are so indisputable that probably nobody questions them, and that in science the bacilli of inflammation of the spleen are considered the cause as well of the usual typical disease as appearing in our domestic animals, as also of the clinically varying type which appears in man.

The course just sketched, which those who strove to prove the parasitic nature of inflammation of the spleen have taken with success, and the conclusions necessarily obtained from the results, I have placed at the foundation of my investigation of the ætiology of tuberculosis. These had to employ themselves in the first place with the proof of disease-producing organisms, then with their isolation, then with their inoculation. I now go over to the description of these single divisions of the investigation.

I.—*Proof of the presence of disease-producing organisms in the organs changed by tuberculosis and in the separation of the latter.*

Disease-producing organisms, which have the size of inflammation-of-the-spleen bacilli and like these, appear in the blood in large numbers, or those which, like the "nekurrensperochaeten" attract the eye, offer no especial difficulties in investigation, and the proof of such micro-organisms can be obtained by ordinary optical helps. The case is different, however, when it is necessary to prove the existence of minute bacteria present in the tissues in only small numbers, especially when cells are heaped up or broken down in the spots concerned, which is almost always the case. Then it is necessary to use the more delicate technical helps of microscopy, as especial methods of preparation and differential coloring, and to pursue the investigations with the best optical apparatus, oil-immersion systems and Abbe's illuminating apparatus.

Also in regard to tuberculosis it was to be expected that to show that special disease-producing organisms do actually exist, might offer special difficulties, as they had already been much sought for, and nothing found that could give confidence in their existence. I began investigations with material in which infectious matter might be expected with certainty, for instance, in freshly developed and still grey tubercles from the lungs of animals which had been killed three or four weeks after inoculation. From these lungs, hardened in alcohol, sections were made and examined according to the most approved methods for proving the existence of bacteria. Grey tubercles were also crushed, spread out on glass covers, dried, and then examined with reference to the existence of micro-organisms. All attempts to find bacteria or other micro-organisms in these prepared specimens proved unsuccessful. In former experiments it had been attempted to color the bacteria as strongly and as differently from the surrounding tissue as possible, and in such attempts it had been proved that in certain cases the addition of alkalies to the color-solutions offered essential advantages; therefore this treatment was adopted. Of the usual analine color the methyline blue will bear the greatest addition of alkali, on which account this coloring material was chosen, and just so much potash-lye was added to a watery solution of the same as to form no precipitate, and that the liquid remained clear. For the preparation of this mixture 1 ccm. of a concentrated alcoholic methyline-blue solution and 200 ccm. of distilled water were mixed, well shaken and during repeated shaking 0.2 ccm. of 10 proc. potash-lye was added. When glass-covered prepara-

tions had been treated twenty-four hours with this color solution, there appeared in the tuberculous mass very fine staff-shaped forms, which, as further investigation proved, had the power of increasing and forming spores, and therefore belong to the same group of organisms as the inflammation-of-the-spleen bacilli. In section preparations it was incomparably more difficult to recognize these bacilli among the thickly heaped grains and masses of detritus, and it was therefore attempted, following the example of Weigert, who, succeeding in the coloring of the inflammation-of-the-spleen bacilli a different color from the surrounding tissues, to make the tuberculous bacilli more plainly visible, by similar differentiating color reaction. This end was reached by the use of a concentrated watery solution of vesuvian, with which the blue colored, covered glass preparations and section preparations were treated so long, till to the naked eye, it seemed colored brown. Under microscopic examination it was then seen that only the previously blue-colored cell grains and the products of their disorganization had taken the brown color, but that the tuberculous bacilli remained a beautiful blue color, and, in consequence of this were very plainly to be distinguished from their surroundings, so that even in the masses of grains, thickly heaped together, they were easily recognized. In the use of methyline blue in the manner just described, the bacilli, however, do not take a very intense color, and it requires a certain amount of practice to be able to prove their existence everywhere in tuberculous objects.

Another method which gives to the bacilli a very strong color, we owe to Ehrlich. I use the same now exclusively, and earnestly recommend it to all who are beginning their studies of tuberculous bacilli. Ehrlich's method has since received many unimportant modifications, partly improvements. Among the latter I would reckon the proportions of solutions as settled by Weigert and the shortening of the color solution, a change recommended by Rindfleisch. If I describe the method in which I use Ehrlich's treatment as exactly as possible, I am nevertheless not of the opinion that the modification which I have followed is the best, or that just as good results are not to be gained by other modifications of the treatment. But the coloring of the tuberculous bacilli appears still to offer difficulties to many investigators, and for this reason, it will certainly not seem superfluous to give as exact directions as possible for the method of coloring.

In order to prepare the color solution, aniline water and saturated alcoholic solutions of methyl violet (to be distinguished from methyline blue) or fuchsine are necessary. The aniline water is prepared in the following manner: About 5 ccm. of pure aniline, an oil-like liquid, at first colorless, afterwards becoming brown, is poured into 100 ccm. of distilled water and this mixture is shaken repeatedly. From three to four per cent. of aniline dissolves in the water and the rest remains in the bottom of the dish in the form of thick drops. After a saturated solution of aniline in water has been formed in this way, which is the case after about half an hour, this aniline water is filtrated through a filter, which has been moistened in order to separate it from the rest of the undissolved aniline. The filtrate must be clear as water and colorless, and no little drops of aniline must be suspended in it. If such have passed the filter, the liquid must be filtrated again.

One obtains the second ingredience of the color solution, the saturated solution of methyl violet, by taking not too small a quantity (20 grm.) of dry methyl

violet in a well closing glass vessel, pouring over it 100–150 ccm. of absolute alcohol and shaking it repeatedly. After standing a day, there must still be undissolved methyl violet at the bottom of the vessel, which of course can also be dissolved and made use of by gradually pouring on more alcohol. When in place of methyl violet, fuchsine is used, which seems to offer certain advantages for permanent preparations, one also proceeds in the just described manner.

After this, the alcoholic methyl violet solution and the aniline water are to be mixed, and according to Weigert in the proportion of 100 ccm. aniline water to 11 ccm. methyl violet solution. I add to this mixture 10 ccm. of absolute alcohol, because I have found that then the color solution remains usable in a well closed glass for about ten days and does not need to be filtered each time before using.

The preparations which are to be examined with reference to tuberculous bacilli are to be prepared in the following manner: Covering glasses are to be freed from fat and all other extraneous matter, which might prevent adhesion of the substance to be examined, by washing in nitric acid and cleaning with alcohol. The substance is then to be spread out on the covering glass in as thin a section as possible. This procedure succeeds best when soft caseous masses are treated; they can be spread out evenly and thin with a scalpel or a needle. Firmer, crumby caseous masses must be carefully crushed with the scalpel and arranged on the glass by spreading out repeatedly. Still more difficult is it to prepare a little tuberculous knot, which possesses a compact consistence. It must be completely crushed and pressed to pieces on the covering glass. The preparation of covering glasses with sputum also demands a special technique. One must not content himself with taking any chance list of mucus from the sputum, since the sputum consists not only of the secretion of the diseased parts of the lungs, but also of bronchial secretion and mucus from the mouth and nose. It is on this account necessary to examine only those parts of the sputum which have separated themselves from the diseased lungs, that is to say, the yellowish lumps which often swim solitarily in the frothy slimy liquid, which to be sure often forms the greatest part of the sputum. Such a lump of this yellowish, extremely tough mass should be drawn to the edge of the glass, then a little bit of it separated with the scalpel, drawn out of the liquid and on to the inner wall of the glass. Here it can easily be further divided, and be taken off in as large particles as one wishes to transfer to the covering glass. On this it is spread out very evenly and thinly, and any residue should be brought to a corner of the covering glass, and from there removed with blotting paper.

After the covering glass has been prepared in this manner, the section spread out upon it must be allowed to become thoroughly dry. Not until this is the case can the covering glass be heated temporarily, in order to make the section insoluble in watery fluids, with which it is now brought in contact. The covering glass can be put into a drying box heated to 110° for twenty minutes, or one can hold the covering glass with a pincette, and draw it several times, not too quickly, through a gas or spirit flame. The prepared section of the covering glass is during this process to be on the upper side and is not directly touched by the flame. That the forms of the bacteria cells, etc., which occur in the section are not changed in the least by this careful process, can be shown by the following ex-

periment. Of several covering glasses, provided with a dried on section, let the first not be heated at all, the second drawn once through the flame, the third twice, etc. When after this the covering glasses are treated with color solutions, it appears that the coloring of the cell grains and bacteria shows no difference between the one not heated at all and those drawn through the flame from one to four times. Also the forms remain unchanged. If the heating is carried farther and the covering glasses oftener drawn through the flame, the bacteria gradually lose the power of taking the coloring material, while the cell grains become colored even after very intense heating. In the covering glasses which have not been heated the section separates itself more or less, often entirely, also the dissolving "eiweisskörper" (white-of-egg bodies) form with the coloring matter precipitates, which cover the section and make the recognition of bacteria very difficult and even impossible. Better results are given by the covering glasses which have been once or twice drawn through the flame, but those drawn through three times give the best. One of these last the section clings uniformly, the "eiweisskörper" are insoluble or so nearly so that no more precipitates are formed, also the bacteria and cell grains take the color, with an even degree of intensity, while the surrounding substance remains wholly or almost wholly uncolored. On this account I always proceed thus: After the sections spread out on the covering glasses have become completely dry, which always takes place in a few minutes, I draw them three times with moderate quickness through a Bunsen burner. The color-solution is placed in a watch glass or a flat vessel, and after the heating the covering glass is laid face downward on the liquid, that it swims. One must be careful that there are no air bubbles under the glass, as otherwise the section would not be wet in these places and therefore not colored. Then let the color-solution be so far heated that it just begins to bubble, and after once boiling leave the coloring glass upon it about ten minutes; the result will be a sufficiently powerful coloring. Better results are nevertheless reached when the covering glass swims for several hours on the unheated solution. In all difficult cases, when one wishes to prove the existence of single bacilli, it is well to leave the covering glass twelve hours or longer in the color-solution.

When one wishes to examine sections of tissues with reference to tuberculous bacilli, pieces of the organ in question, not too large, are to be well hardened in absolute alcohol. Other hardening processes make difficult or even hinder the coloring of the bacilli. The sections need not be very thin, because by means of the double coloring, single bacilli can be distinguished very easily even in quite thick sections. Nevertheless, it is more to the purpose to prepare large sections, since the distribution of the bacilli is often very irregular, therefore it is possible that in small sections no bacilli may be found. The use of the microtome in the preparation of the sections is for this reason almost invaluable. The sections are immediately laid into the color-solution and remain in the same at least twelve hours. They can remain in it several days without injury.

The sections as well as the layer clinging to the covering glass have, when taken out of the color-solution after the given time, a dark blue, almost black-blue color. In this condition all parts of the tissue are almost evenly dark colored, and it is scarcely possible to recognize the coarser structures. In order to make the preparation suitable for microscopic investigation, a great part of the coloring

material must be removed again. This can be done in various ways. In the method originally used by me, of coloring with alkaline methyline-blue solution, I had found that the blue coloring of the constituent parts of the tissue could be driven out by treating with a solution of vesuvian. The same can be carried out in the preparations which are colored according to Ehrlich's method. When these preparations are rinsed off in water and then put into a concentrated watery solution of vesuvian, moved back and forth in the same, and finally put into alcohol, one succeeds in almost completely drawing out the dark blue coloring. The preparations, nevertheless, lose their color more quickly and completely by Ehrlich's method of treating them with nitric acid. That this can be done by other aniline coloring materials, as for example the above mentioned vesuvian, I have mentioned only for the reason that by many the effect of nitric acid has been erroneously held for something specific, but this is not the case, since other acids work similarly.

For taking the color out of the preparations, nitric acid, which has been diluted with two parts of water, is commonly used. So strong a concentration of the acid is nevertheless not absolutely necessary, and of late I use acid diluted with from three to four parts of water. Perhaps one can go even farther in the dilution. One should take care, however, that the nitric acid is free from nitrous acid.

When I spoke of the uncoloring of preparations by means of nitric acid, I followed the description which Ehrlich gave of his process. By the treatment of the covering-glass preparations with nitric acid, this term is exact, when the preparations are not intensely colored; after a stronger coloring, which gives decidedly better and more reliable results, the nitric acid after a few minutes fails to take all color from the dyed section, and section preparations, which, as it has already been carefully shown, must be colored a longer time and very intensely, always keep, after the nitric acid treatment, quite a dark coloring. The expression "uncolor" is not to be understood literally. The failure of bacilli-coloring appears in most cases to have had its foundation in this very thing. The experimenters thought that the preparations after treatment with nitric acid must be wholly colorless, and in order to reach this, partly colored too little the preparations, and partly left them too long in the acid.

When section preparations have lain in the solution twelve hours, and are then put into nitric acid, they lose their black-blue color in a few seconds and take a greenish-blue appearance. If they are then put into distilled water, the tone of the color changes directly. It becomes again noticeably darker and changes into blue, with a bit of violet. The nitric acid, therefore, has left a coloring matter in the preparation, which is insoluble in water, and in connection with water takes a darker tone. That this remainder of coloring matter is not easily soluble, even in nitric acid, can be easily shown. If the section be again dipped into the acid, their color will again become greenish-blue, but not paler than in the first treatment with the acid, and if washed again with water, they will again take the former dark coloring. I conclude from this that a longer remaining of the preparations in the acid is of no value for their further uncoloring, and leave them therefore, only a few seconds, at the highest half a minute in the same. On the contrary, I have found that the coloring matter in the preparations remain-

ing unaffected by nitric acid, is soluble in alcohol from sixty to seventy per cent. if the preparations are put immediately from the acid into the alcohol. A longer remaining of the preparations in alcohol appears to make the coloring matter finally insoluble also for alcohol, and it is therefore to the purpose not to wash the preparations in water after their treatment with nitric acid, but to place them directly into the alcohol.

The method of uncoloring followed by me is as follows: By the help of a platinum wire, which is melted into a little glass staff, the preparations are lifted out of the color-solution and laid into nitric acid diluted with three to four parts of water. In this they are moved back and forth for some seconds, until they have taken a greenish blue color, and are then put directly into a vessel with 60 per cent. alcohol. In the alcohol they remain only about ten to fifteen minutes, after which they receive the after-coloring now to be described.

In preparations treated with nitric acid and alcohol the component parts of the tissue are wholly colorless, or possess only a slight bluish tone of color, while the tuberculous bacilli have retained an intense blue color. Relative positions of the bacilli to their surroundings, are, owing to the nature of the preparations, difficult of proof. It is also very difficult to find single bacilli in the tissue, whose structure is made as good as completely invisible by the peculiar method of illumination, which will be described later, and for this cause it is necessary to give to the tissues a coloring of the nucleus. In order to obtain as striking a contrast as possible, between the coloring of the bacilli and the cell-grains, a yellow or light brown is chosen for the supplementary coloring material, when the bacilli are blue; a green or blue is chosen when they are red. For the first case vesuvian is best adapted, for the second methyline blue. Both coloring materials must nevertheless be used only in weak solutions, and not for too long a time, in order that just sufficient coloring of the grains may be obtained, lest single bacilli be hidden by too darkly dyed masses of grains. I use for the second coloring a watery, freshly filtered vesuvian-solution, which to a depth of 2 ccm. is just barely transparent. On this the uncolored covering-glass preparations are so laid that they float with the prepared section downwards. Section preparations remain in it some minutes. It is not necessary that the section preparations, when they are brought from the alcohol into the vesuvian solution, should be completely colorless, because they must later be again treated with alcohol, in order to get rid of the water in them, and will then lose whatever blue coloring matter will have remained.

One takes the preparations out of the vesuvian solution and puts them again into ten per cent alcohol and out of this into absolute alcohol. The further treatment is the familiar one, only it is to be recommended that for brightening the preparation, instead of oil of cloves, oil of turpentine, or still better, cedar-oil be used, as these do not draw the aniline out of the preparations. With reference to enclosing them with Canada balsam, I would say that a balsam diluted with oil of turpentine appears to be the best adapted. Very thick balsam, which must be warmed in order to enclose the preparation, must not be used, because in warming, the tuberculous bacilli usually lose their color quickly.

Covering glass preparations can be examined immediately after the washing off of the vesuvian solution with water, or they can be dried again and enclosed

in Canada balsam. For the examination of the sputum with reference to tuberculous bacilli, the second coloring can as a rule be omitted, so that the microscopic examination of such sputum preparation follows immediately upon the treatment of the same with nitric acid and alcohol.

For the sake of a general view, I will recapitulate briefly the whole coloring process: covering glass preparations dried in the thinnest possible section, after the drying, three times heated in the flame; section preparations of objects, which are well hardened in alcohol; coloring of a solution consisting of 100 ccm. of aniline water, 11 ccm. of alcoholic methyl violet solution or fuchsine, 10 ccm of absolute alcohol; the preparations remain in the color solution at least twelve hours (the coloring of the covering glasses can be shortened by warming of the solution); treatment of the preparations with diluted (1:3) nitric acid for some seconds; washing in 60 per cent. alcohol for several minutes; (for covering glasses, moving back and forth in alcohol several times is sufficient); second coloring in diluted vesuvian solution or methyline blue for several minutes; washing again in 60 per cent. alcohol, getting rid of water by means of absolute alcohol, brightening in cedar oil; microscopic examination of the preparation; enclosing of the preparation in Canada balsam if the same is to be preserved.

As to the microscopic examination of the objects prepared in this manner, all that I have said in other works* about objects colored for the microscope, holds true also for these. In this case also structural relations, which make themselves manifest by the varying refractive power of the single parts of the tissue, are not to be settled; it concerns us only to see the various color relations of the microscopic objects, that is to say, representations of absorption, as clearly and sharply as possible. The structural image whose effect is only disturbing must therefore be gotten rid of, which, as I have shown, can be done most completely with the help of the well-known illuminating apparatus of Abbe. The peculiar illumination which this apparatus affords when it is used without "abblendung," cannot be borne by all systems of lenses. The last must be constructed with special reference to this method of illumination. The greater an opening angle a system possesses, the better it is adapted for the observation of the images of absorption, with help of Abbe's illuminating apparatus. For this reason oil-immersion systems can accomplish the most in the investigation of colored objects.

The covering-glass preparations, if rightly prepared, must possess so little thickness that the structure is formed of a single layer of objects, and in and of itself is little to be considered. These preparations can on this account be examined simply in water and in case of need, a system of water-immersion is sufficient for them, if the field of vision be sufficiently brightened by a condenser. In the case of section-preparations, it is, on the contrary, impossible to set aside the structure formed by so many layers of tissue one above the other, unless the preparation is laid in a liquid which has high power of refraction. It is necessary to do away with the differences in refraction of the tissue, and to use the full illuminating power of Abbe's apparatus, and must use its full power to the best advantage through the large opening angle of an oil-system. One may easily con-

*Untersuchungen ueber dis Aetiologie der Wundinfectiouskrankheiten. Leipzig 1878, p. 31, etc.

Mitthellunengen aus dem Kaiserlichen Gesundheitsamte. 1881, Vol. 1, p. 9.

vince himself of the necessity of the optic helps here described as absolutely necessary, if one first examines a properly colored section in water and examines it microscopically by a dry system or a water-immersion system and a comparatively narrow "blendi" (blind or opening). Fine distinctions of color, and small colored bacteria in tissues, which are to any extent rich in grains, can under these conditions scarcely be distinguished. Also placing the section in glycerine changes almost nothing, because the differences in refraction of the parts of the tissue are equalized much too slowly and insufficiently. A noticeable improvement is gained by brightening the preparation by means of highly refractive liquids, such as oil of cloves, oil of cedar, etc.; for the brightening rests upon the more or less thorough destruction of the structure-image. But even this improvement is not sufficient to allow the color-pictures to appear in full clearness and sharpness. Only the quantity of light pouring in from all sides by means of Abbe's illuminating apparatus and the oil-system can fulfill this task. Who only cares to examine covering-glass preparations, without caring for complete certainty with regard to the state of things, for him a microscope with water-immersion system and without illuminating apparatus, will in case of need prove itself sufficient. Dry systems are not to be used for bacteria investigations. As soon as reliable investigations of finer bacteria are to be undertaken, or if one wishes to gain an independent judgment as to the newer results of bacteria research, it is absolutely necessary to have at hand the very best optic helps, that is to say oil-immersion systems and Abbe's illuminating apparatus. With regard to the magnifying powers which must be used for the examination of tuberculous bacilli, I will remark that 500–700 fold magnifying power is most to the purpose, and that this is best reached with an oil system $\frac{1}{12}$ of an inch and the corresponding oculars.

In the practical use of the coloring processes just described, the component parts of the tissue of the body conduct themselves almost without exception differently from the tuberculous bacilli. While the latter, in spite of the treatment with nitric acid, alcohol and vesuvian, keeps the dark blue color which they have taken, the remaining animal tissues, as already mentioned, lose the blue color again, and in the second coloring the grains of the cells as well as the products of destruction of the latter, further the little grains of the plasma-cells are dyed brown. Only some parts of the tissue make an exception, as hair and epidermis, which remain more or less blue-colored. Since in these last tuberculous bacilli are hardly to be sought for, the finding of bacilli in the tissues is made exceedingly easy, by their characteristic conduct towards aniline coloring matters. Even in the closest masses of grains and in the midst of broken down cells, which often take all possible forms, from the smallest little points and micrococci like forms, to the longish staff-like forms, one can with absolute certainty distinguish single tuberculous bacilli from these closely similar forms by means of their dark blue color, which in the brown-colored surrounding and owing to the light-absorbing power of the brown ground appear as staffs almost colored black. This noticeable difference in the color-reaction holds nevertheless, as must constantly be repeated, only for the method of coloring described here. A different preparation of the objects than the quick and good alcohol hardening of the organs, made the condition here, appears to bring about

other relations. For while usually the little grains of the plasma-cells conduct themselves like the cell-grains and show a different coloring from the tuberculous bacilli, I have lately seen a preparation, made by Dr. Benda's assistant in the pathological institute in Göttingen, in which tuberculous bacilli were not to be found, but on the contrary the grains of the plasma-cells showed themselves colored blue. Probably in this case the object from which the section was prepared had received a treatment with cromic acid or had not been hardened quickly enough in alcohol.

Accident comes to our help in proving the existence of tuberculous bacilli, since not alone the parts of the tissue take a different coloring, but also all other bacteria which I have known until now and examined, with the exception of the lepra-bacilli to be mentioned later, also react in an opposite manner from the tuberculous bacilli under Ehrlich's method of coloring. Bacteria coming from the mouth are almost always to be found in phtisic sputum. I have never seen that one of these numerous sorts of bacteria showed the same color-reaction as the tuberculous bacilli. This observation has been confirmed by many reliable investigations, and can be considered as an established fact. The same is true of the tuberculous bacilli occurring in the contents of the intestines, when tuberculous ulcers are present. When this sort of discharge is prepared and colored in the prescribed manner on the covering-glass, it appears to consist almost wholly of bacteria; they fill the layer in such thick masses. But without exception they take a different color from the tuberculous bacilli, and especially is this the case in the smaller sorts of bacilli, which might perhaps lead one to mistake them for. A peculiar behavior is shown by a large sort of bacilli, which form somewhat large, oval spores standing on ends, in that the spores often keep a plainly manifest, sometimes indeed an intense blue color, while the substance of the bacillus is itself dyed brown. According to all appearance these spores only take the color a short time after their formation, but remain uncolored after they are older. Among the many spores of the contents of the intestines which belong to other sorts of bacilli, until now none have been found which took the color of the tuberculous bacilli. Also the spores of the inflammation-of-the-spleen bacilli, hay bacilli and others, which Dr. Gaffke examined at my instance with reference to this color-reaction, remained uncolored. On the contrary Dr. Gaffke found during these investigations that the spores of "shimmel-pilze" take a strong blue. Also a certain kind of yeast seems to take the color. Since a mistaking of tuberculous bacilli for the above mentioned spores and yeast is impossible, their diagnosis so far as it rests upon the color-reaction is not thereby prejudiced.

Of late I have examined many sorts of bacteria-bearing substances, such as decaying meat infusion, decomposing urine, blood milk, vegetable infusion, mire from swamps with Ehrlich's coloring method, but have never found bacteria which take the same color-reaction as the tuberculous bacilli. I must therefore consider all claims for the appearance of bacteria which conduct themselves in regard to color exactly like the tuberculous bacilli, and which are said to be found in sputum, decaying liquids, the contents of the intestines in healthy men and in swamp-mud, for mistakes and resting upon an erroneous use of the coloring method. I feel myself so much the more justified in this opinion since I almost daily see examples of the difficulties which the use of this certainly rather complicated color technique offers to most people.

Aside from the tuberculous bacilli, until now only one sort of bacteria has been known which takes color in the same way as the tuberculous bacilli; these are, as I have already mentioned in my first communication, the lepra-bacilli. This fact is so much the more worthy of notice, since not only the parasites belonging to tuberculosis and to lepra are similar in many ways and plainly nearly related, but, as is well known, those two diseases stand very near to each other anatomically as well as ætiologically. To be sure, the coloring properties of the two sorts of bacilli are not identical. For although the lepra-bacilli can be colored by the same process as the tuberculous bacilli, the opposite is not the case. The first take, as is well known and as Neisser first proved, the nucleus-coloring of Weigert, which the last do not. However similar the two bacilli are in figure, size, &c., as soon as it comes to a diagnostic distinction, it becomes easy to recognize them through their different response to Weigert's nucleus-coloring.

The example of the lepra-bacilli already teaches that the tuberculous bacilli occupy in no way an entirely exceptional position in regard to their response to coloring matters; it is therefore not improbable that in course of time other sorts of bacteria will be found, which possess the same or similar coloring properties as the tuberculous bacilli. But any influence on the apprehension of the ætiological importance of the tuberculous bacilli would not be exercised by such a discovery. For the special reaction against coloring matters is nevertheless not the only specific property of the tuberculous bacilli. They possess, as we shall see later also in biological relations, a number of other peculiarities, which give still more weighty reasons for separating them from the known bacteria as a specific sort.

In all such considerations it is very much to the point to bring to remembrance how the same relations exist in inflammation of the spleen. One will then see that inflammation-of-the-spleen bacilli possess no specific coloring qualities and nevertheless, as is universally acknowledged, are bacteria of a distinct kind and form the cause of inflammation of the spleen. Exactly the same might be the case with tuberculous bacilli if they did not accidentally distinguish themselves from other bacteria by color-reaction. If the latter is nevertheless a fact, it is certainly of value in diagnosis, but it is a great error to think that with the specific color-reaction of the tuberculous bacilli, their ætiological importance stands and falls.

Further it appears to me not improbable that in the near future still further methods may be found by means of which tuberculous bacilli can be colored. Ehrlich's coloring method has already experienced many modifications, of which theoretically the most worthy of notice is the fact found by Ziehl, that aniline can be replaced by other substances, such as phenol,—$C_6H_4(OH)_2$ —resorcine, &c. The statements of some authors, that the tuberculous bacilli may be dyed with pure fuchsine appear to hint that still other ways exist in which the coloring can succeed. The diagnostic importance of Ehrlich's method, even if other methods which have no exclusive character are found, suffers by no means. For that remains in spite of all a well established fact, that by strict following of Ehrlich's method the tuberculous bacilli conduct themselves in a manner wholly peculiar to them and are thereby to be distinguished from all till now known bacteria. The method has the value of a chemic reaction, which has made possible the distinction of substances difficult to divide, nevertheless only under the condition

that it be used exactly according to the given directions. It would be of special interest to be able to give the bacilli a brown or yellow coloring, because only under this condition would it be possible to get usable photographs of the tuberculous bacilli. Of late I have, to be sure, succeeded, with the help of a previously given treatment of the preparations, with a very weak solution of kali ($\frac{1}{10}$ p. M.) to color the tuberculous bacilli a quite intense brown, nevertheless the preparations do not meet the demands required for photography. It is to be hoped that this difficulty will be overcome. But for the present I have been obliged to do without photographs, however much I have wished by means of photographs to render possible a reliable comparison between the form and size of tuberculous bacilli and other similar ones.

As another hindrance in the coloring of the tuberculous bacilli the temporary character of the coloring must be mentioned. After a shorter or longer time in the preparations enclosed with Canada balsam, the color of the bacilli begins to lose its intensity, very gradually it becomes less noticeable and finally vanishes completely. The preparations colored with methyl-violet and gentian violet pale most quickly, for in some cases the color of such bacilli vanished in two days. The preparations colored with fuchsine keep much longer, as do those colored with alkaline methyline blue solution. Why it is that the color is so fleeting, while the same color in the dyeing of other bacteria have proved themselves unchangeable for years, I am not able to say. But from the circumstance, that in a great number of prepared specimens single ones have been found which have preserved the color completely unchanged for almost a year, I must conclude, that some sort of conditions are present and may be found, which will make possible the retaining of the color.

Moreover the preparations which are so pale have not become entirely useless, as with little trouble they can be colored again. The Canada balsam must be liquified by heat, the specimen taken off carefully with a pinsel and put into oil of turpentine. After 24 hours it is laid in absolute alcohol and after another 24 hours into the color solution to go through the whole coloring process again. The tuberculous bacilli take the blue color just as intensely as at first, but their surroundings, on the contrary, appear less beautifully and clearly colored than before.

A reliable explanation of the difference between tuberculous bacilli and other bacteria in their action in regard to coloring matters appears to me impossible for the present, on account of the insufficient knowledge of the more delicate structure of the chemical constitution. On many grounds it seems likely that the tuberculous bacilli are surrounded by a coating, which acts differently toward coloring matter than the contents, as we already know to be the case with other bacilli. The bacilli dyed with methyline blue appeared thinner than those dyed with methyl violet or fuchsine. One sees in the groups in which the bacilli lie closely pressed together, that the methyl violet colored bacilli move, and the bacilli dyed with methyline blue and appear thin, are separated from each other by plainly manifest spaces. Further, the coloring of the bacilli intensely dyed with methyl violet in growing pale does not vanish uniformly, but an outer layer grows pale first, so that of the thick bacillus a thinner still intensely thread remains, which possesses about the thickness of the bacillus colored with methyline blue. Finally the firm cleaving together of the bacilli in the groups also speaks for the presence

of an enwrapping substance which joins them. It is therefore thinkable, that a coating exists, possessed with special properties, and enwrapping the bacilli, and that this allows the entrance of coloring matters under the simultaneous influence of alkali aniline and similar matters, but is on the contrary more or less impenetrable for acids. But in the face of the facts now known, one cannot go farther than to conjectures.

If I now go over to the description of the tuberculous bacilli themselves, although they were first made visible by the help of coloring matters, it appears nevertheless to the point, first to describe their properties as they make themselves known in a living condition and without being influenced by any sort of reagents. To get preparations for this sort of observation, only such tuberculous substances can be used as contain considerable masses of bacilli, because single bacilli cannot be distinguished with certainty in the masses of detritus without help of the color reaction. For this purpose I have used little tuberculous knots from the lungs of guinea pigs, after I had convinced myself by coloring of the great quantity of tuberculous bacilli in them; the little knots were crushed in a drop of blood serum free from bacteria, the substance spread about as finely as possible in the liquid, a drop of this liquid sufficiently large for microscopic examination spread out flat on the under side of a covering-glass and fastened with vasiline on to a hollow object-holder, in order to avoid disturbing currents in the liquid and a too quick evaporation. In a preparation prepared in this manner, in the microscopic examination conducted in the usual manner, that is to say in a suitable "abblendung" of the light by diaphragms, there are found among opaque heaps of indeterminable nuclei, brighter spots in which the formed elements lie less thickly, and here one notices numerous colorless, very fine and short little staffs. The same are mostly united in small groups; in those which lie singly aside from the so-called molecular motion, no motion of their own is to be noticed. The length of the little staffs is about from one-quarter to one-half of the diameter of a red blood corpuscle. An organization is not be noticed in them, and one cannot reorganize their relations to the surrounding cells in this sort of examination, and if no farther observations could be made, one would rather believe he had some sort of lifeless forms before him than bacteria.

If such a covering-glass be lifted up from the concave object-holder, so that the bacilli-bearing substance be dried and then doubly dyed in the manner already described, then the numerous grains and remains of cells appear dyed brown, the little staffs on the contrary receive an intense blue coloring and distinguish themselves sharply from all known component parts of the animal tissue with which they are mixed. The bacilli do not show themselves in their full number until after their coloring; they may be distinguished not only on the thinnest spots of the preparation, but everywhere with full certainty, even among the thick heaps of cells. It is noticeable that the little staffs appear thinner after the coloring than in the uncolored condition, the reason for which is, that before the coloring they must be observed by light cut off by diaphragms, in which case the lines of interference on the borders of the object appear to enlarge its diameter, while the observation of the colored bacilli is made in full light falling upon it from all sides, through which all phenomena of interference are excluded.

In like manner one can examine the most various objects by spreading out the substance to be examined as to its contents of tuberculous bacilli on the covering-glass and by coloring the same. Nevertheless, one does not learn much more than that the bacilli are present in a tissue or in a liquid and in what quantity they are present. Their position and their relations to the surrounding tissues cannot, in this way at least, be determined. The examination on the covering-glass is therefore sufficient for liquids, but for tissues can only have a preliminary, provisional character. Only the examination of the prepared sections of hardened parts can give reliable information as to the presence and diffusion of bacilli in the tuberculously altered organs.

To find out whether bacilli are regular accompaniments of tuberculosis, I have examined as extensive a ground as possible. Materials for this investigation I have received for the most part from Dr. Friedlaender, who, at my request, and in the most obliging manner, made the rich material of the city hospital in Friedrichsham accessible to me, and from the director of the city hospital in Moabit, Dr. Guttman, who committed to my charge a number of cases of tuberculosis for examination. It is a pleasant duty in this place to thank both gentlemen for the help they have given to my work.

In the following description of the results gained in these investigations I must, in order to make a general survey, omit the historical enumeration of the single cases in the order in which accident placed them in my hand, and will speak of them as grouped according to the usual anatomic points of view. Before I turn to this, however, I must make a few general remarks. When a little tuberculous knot is examined in prepared sections, without the use of nucleus-coloring, and without the diffused light of Abbe's illuminating apparatus, it appears like a body formed of cellular elements thickly crowded together and therefore only slightly transparent. As soon as the little tuberculous knot becomes caseous in the centre the cells change into a more or less fine grained, almost opaque mass, in which fine details are not to be distinguished. But a thoroughly different image of the tubercle is gained when the prepared sections are laid into strongly refractive media and the examination is undertaken after the nucleus-coloring, and by diffused illumination. The youngest tuberculous knots then show themselves to consist of colored grains heaped together. Nevertheless the grains are not so closely packed but that a section of ordinary thickness appears transparent enough to make it possible to distinguish the most delicate form elements occurring in the space between the grains. The caseous centres of the tuberculous knots in the prepared section appear wholly changed; they appear almost uncolored and completely transparent because there the cells have died and take no coloring; only here and there in them are found the remains of nuclei going to pieces, in the form of colored grain groups which, to be sure, are pretty closely pressed together but still allow all single form elements to be distinguished. Larger caseous herds conduct themselves in the same manner. The caseous substance itself has become completely transparent by the treatment and shows only a light greyish-yellow color tone interrupted by single brown grains or groups of grains. Every single tuberculous bacillus can be distinguished with ease. The conceptions of the microscopic image of the tubercle and of the tuberculously altered tissue which usually obtain are to be modified according to the circumstances just described when the

examination of the pictorial reproduction of prepared specimens with nucleus-coloring and illuminated by diffused light is concerned.

As to the qualities of tuberculous bacilli in general, as they manifest themselves in the colored condition, the following is still to be mentioned.

They always appear in the form of little staves whose length, as has already been given in the description of uncolored bacilli, is equal to $\frac{1}{4}$—$\frac{1}{2}$ of the diameter of a red blood corpuscle (about 0,0015—0,0035 mm). The diameter of the thickness is as constant as the length of the bacilli is variable, provided that one and the same coloring method is used. Under the coloring method first used by me, with alkaline methyline blue solution, they appear considerably thinner than with the use of Ehrlich's method. It is difficult to fix the slight size relations about which we are here concerned without the use of photography. When I look through a considerable number of my bacteria photographs for bacilli which correspond best as to size with tuberculous bacilli, I find in F. Cohn's "Beitrage zur Biologie der Pflanzen," II Vol., 3 Book, in the photographs given in Plate 15, No 1, among club-shaped bacilli with spores fixed in their ends, very thin and small bacilii which, if magnified 700 instead of 500 times as in the photograph, would come nearest to the tuberculous bacilli. There are among these bacilli also some which are spore-bearing and which about give a representation of the spore-bearing bacilli to be mentioned later. Also in the bacilli taken from blood putrefaction in mice (Mäuse septicämie) and shown in this work, Vol. I, Plate VII, Fig. 41, are bacilli almost as thick, but on the average somewhat shorter than tuberculous bacilli.

The tuberculous are usually not completely straight little staves; one usually finds slight breaks or bends and sometimes a crookedness which in the longest specimens goes so far as to suggest screwshaped windings. By this varying from the straight-lined forms the tuberculous bacilli distinguish themselves from other bacteria which come noticeably near them in size relations according to the photographs.

The distribution of the bacilli in the tuberculously-altered tissue is a very varying one. Sometimes they are heaped together in dense masses, so that by a very slight magnifying power bacilli-bearing spots can be recognized by their blue color. Very frequently, however, they are present only in small numbers. One finds the bacilli with most certainty where the tuberculous process is just beginning or is in a state of rapid growth. Here they are to be found in moderate numbers and between the nuclei of the cells which are heaped together and which usually show the epithelioid character at an early stage. After a more careful observation it is manifest that a bacillus almost always lies close beside a nucleus, and that it is to be found in the interior of the cell belonging to this nucleus. One cell can often contain two or even three bacilli. In places where the disease has made greater progress the number of bacilli usually increases extraordinarily. They then often group themselves into little heaps closely pressed together, in which the bacilli lie parallel and are connected, so closely that it is often difficult to recognize the fact that the group is composed of single bacilli. In this arrangement the tuberculous bacilli bear a great resemblance to the lepra bacilli, which are mostly grouped in this manner. The relation of the tuberculous bacilli to the cells cannot be decided in this stage, because the cells have already experienced great changes and

are in process of dying. Their nuclei begin to decompose and to change themselves into irregularly formed grains of very varying size. Gradually these become scarcer and there remains a uniform mass which will not take nucleus coloring and in which all the cells originally present have died. This mass forms what was formerly considered the essential part of the tubercle, as the bearer of the infectious material, namely, the caseous centre of the same. But, as a rule, this caseous substance is very poor in tuberculous bacilli. Only when the death of the cells and their change into the nucleusless caseous mass has taken place very quickly are the bacilli visible for a time in considerable numbers. It is plain that they retain the capacity of fixing the coloring matter longer than the cells perishing under their influence. But very soon the bacilli themselves undergo farther changes, either dying or go into the stage of spore formation, in which they gradually lose their power of taking color. In the last case only their spores remain in the caseous substance, and as until now no means have been found of coloring the spores of tuberculi in any way whatever, their presence after the vanishing of the tuberculi betrays itself only by the infectious qualities of the caseous substance in which they are imbedded. On account of the importance, formerly and even very lately, erroneously attached to the caseous products of the tuberculous process, it may not be superfluous emphatically to direct attention to the facts that in all tuberculous affections the tuberculi appear first, collections of cells joining themselves to these; and that the dying of these cells and the caseous change resulting from this are secondary processes.*

The opinion which still, to a great extent, holds ground that the relation between the bacilli and the caseous degeneration is the opposite of this, that the becoming caseous represent the primary, and that by means of this a suitable breeding ground is prepared for the tuberculous bacilli, is therefore completely erroneous. For the anatomical comprehension of the tissue changes in consequence of tuberculosis the process of becoming caseous may be of interest, but for the ætiology of tuberculosis it has not the slightest importance.

If I have lately been charged with paying too little attention to the process of caseous degeneration in my account of the ætiology of tuberculosis, the charge is unfounded, for it rests upon a misunderstanding of my standpoint, since I have only treated the ætiological relations of tuberculosis, but have left the pathological details to the pathological anatomists, especially when they lie so far aside from ætiology as the caseous changes of the tuberculous tissue.

Of greater importance for the questions interesting us here are the relations of tuberculous bacilli to the gigantic cells so frequently appearing in tuberculously altered tissues.

These peculiar formations are so frequent in tuberculous tissues that it was for a time believed that they must be considered as characteristic of tuberculosis. Since the gigantic cells are almost always situated at the centre of the little tuberculous knot, the opinion has often been expressed that the tuberculous virus must be contained in their interior —has indeed been pointed out in the shape of very small grains.

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* Baumgarten, "Ueber die Wege der tuberkülosen Infection." Zeitschrift f. klin. Med. Bd. VI, heft. I.

It has now been shown to be certain that the gigantic cells occur in other disease processes and are not specific products of tuberculosis. Nevertheless the conviction that the infectious material must be contained in the gigantic cells has proved itself correct. For as soon as gigantic cells appear in the tubercles, tuberculous bacilli are almost regularly found in them, and the relation of bacilli to gigantic cells is a manifold one.

In all slowly developing tuberculous processes, for example scrofula, spongy inflammation of the joints, etc., in which the bacilli are present only in scanty numbers, we find the bacilli almost exclusively in gigantic cells, and then always only one or at most a few specimens in each cell. But when, corresponding with the more or less intensive course of the process, the bacilli appear in considerable numbers, then the gigantic cells which may be present are more generously supplied with them, and the number of bacilli enclosed by a gigantic cell may reach fifty or more.

A single bacillus in the interior of a gigantic cell is sometimes not easily recognized, for it often happens that the little staff may not be in the horizontal plane of the prepared section, but is placed diagonally or perpendicularly, and then appears in the microscopic image not as a blue line but only as a point, which can only be traced to a certain distance and its staff form recognized by raising and lowering the tube. Since the contents of the giant cell take a more or less brown-color tone, the little staff does not always show itself in the characteristic blue, but in a darker, almost black color, the reason being that aniline brown absorbs the blue part of the spectrum, and therefore a blue object observed through a brown solution, must appear black. Attention should, by this opportunity, be given to the fact that bacilli never look blue but always black when the ground on which they are seen is brown, when, for example brown-colored nuclei lie under them.

Although, as already said, it may sometimes be difficult to find a single bacillus in a gigantic cell, bacilli which in considerable masses fill a giant cell give a so much the more striking picture, which cannot be overlooked, even by a weak magnifying power. In this case the giant cells appear like little blue circles which are surrounded by a brown wall, the nuclei of the giant cell.

The arrangement of the bacilli in the giant cells often takes a very peculiar form. When the nuclei of the giant cell form a closed ring, and, for example, only one bacillus is found within it, the same generally lies in the centre or at least only a little excentric.

The nuclei of the giant cell are often forced toward one end, that is in a unipolaric arrangement, especially if the cell possesses an oval figure, or one even longer in proportion to its width. In this case the bacillus is usually found in the part of the cell free from nuclei; it often takes a position exactly opposite to them, and lies in the extreme point of the nucleus free pole. In the observation of the giant cells the supposition involuntarily forces itself upon one that a sort of antagonism exists between the nuclei of the giant cell and the parasite enclosed by it, which effects the greatest possible distance between the nuclei and the bacilli. This remarkable opposition between nuclei and bacilli is most noticeable in those giant cells whose nuclei are grouped equatorially and which then a bacillus in each of the nucleus, free poles, or by a bipolar arrangement of the

nuclei in which, each heap of nuclei holds a bacillus as it were in check.

Also where larger numbers of bacilli are observed in giant cells the oppositional grouping of nuclei and bacilli can be noticed. Usually, however, an entirely different arrangement of bacilli occurs. It looks as if with increasing numbers the behavior of the bacilli towards the nuclei became more active. They force themselves, namely, more and more towards the periphery of the cell, squeeze themselves between the nuclei and finally break through the wall of the nuclei.

During this process it is very worthy of notice that the bacilli, in this case, regularly place themselves with their axis perpendicular to the surface of the giant cell, so that in a microscopic image if the upper curvature or the base of the gigantic cell be shown, they appear as points; when, on the contrary, the greatest diameter of the cell is show, we get the image of a circle of rays formed of blue staffs.

Such a great increase in the number of bacilli appears regularly to be followed by the destruction of the giant cell; for in the neighborhood of giant cells supplied with radiately arranged bacilli, especially towards the interior of the tuberculous herds, one often finds groups of bacilli which show the radiate arrangement, but are no longer enclosed by brown-colored nuclei. Moreover, since many transitional forms are found, it cannot be doubted that such radiated groups of bacilli mark places in which giant cells were formerly found, whose nuclei have vanished, and of whose contents only the bacilli remain.

By the help of the microscopic images just described one can read about the following conception of the relations of bacilli to the cell contents of the tubercle without losing oneself in too venturesome hypotheses. The first stage in the development of the tubercle is the appearance of one or more bacilli in the interior of cells which bear an epithelioid character. How the bacilli get there can scarcely be explained, otherwise than that they are taken up from already existing tuberculous herds and carried along by such tissue elements as possess motion of their own, that is to say, by wandering cells, be they in the blood, the lymph, or in the tissue itself, for the bacilli possess no motion of their own. Only so is the peculiar fact to be explained that frequently single bacilli or little groups of the same are found dispersed at quite uniform and comparatively great distances from each other, as, for example, in scrophulosis, fungous and lupous tissues and in general in all chronic tuberculous affections. For a wandering cell which has taken up a bacillus takes therewith no such harmless burden as if it swallowed a grain of cinnabar, a particle of coal or other indifferent material. Laden with the latter it can still go over much ground, but under the deleterious influence of the bacillus changes occur in the wandering cell which soon bring it to a standstill. Whether the wandering cell perishes, and the bacilli are taken up by other cells present at the spot, which last then take an epithelioidal character; or, as appears to me more probable after my investigations, the wandering cell transporting the bacillus itself changes into an epithelioid cell and after that into a giant cell must be decided by stndies directed to that special point.

For the assumption that the bacilli are originally carried along by wandering cells, and that their dispersion in the tissue depends upon this, the following reasons can be given: In the first place I would like to bring to remembrance an

analogous process in which also staff-shaped bacteria are incorporated by the colorless cells of the blood. This case is the putrefaction of the blood in mice (Mäuse-septicämie) described by me in the "Investigations of the Ætiology of Infectious Diseases." In this disease bacilli very similar to the tuberculous bacilli are to be found in the interior of the white blood corpuscles, and at first there are only one or two specimens close to the nucleus; then they increase very rapidly in the cell, destroying the nucleus and finally bursting the cell in order, having become free, to be again taken up by other cells and to prepare for them a rapid ruin, so that in a short time the majority of the white blood corpuscles are found inhabited by bacilli. The tuberculous bacilli grow, as we shall see later, very much more slowly than the bacilli of septicämie (putre. of blood), and the cells laden with them can therefore manifest vital functions very much longer. The further course of both diseases is, in accordance with this fact, very different, in spite of the fact that the first beginnings of the bacteria invasion possess such great similarity.

Direct observation also speaks in favor of the assumption that tuberculous bacilli are first seized and transported by the wandering cells. This can best be recognized in the cases in which considerable numbers of bacilli are introduced directly into the course of the blood, for example, by injection into the ear veins of the rabbit. If an animal infected in this manner be soon killed, one still finds in the blood numerous white blood corpuscles which enclose one or more tuberculous bacilli, and moreover in the tissue itself of the lung, liver and spleen, genuine round cells appear which are provided with a simple or divided nucleus, still possess no epithelioid form, therefore exactly resemble the colorless blood cells and yet contain tuberculous bacilli. Another explanation of this, other than that they are wandering cells which took up the bacilli in the course of the blood and transported them into the neighboring tissue, will scarcely be found Also in the case of guinea pigs into whose bauchhöhle (belly cavity) considerable numbers of tuberculous bacilli were injected, and which died in the course of the first week, the same appearances were found.

A third ground for this assumption appears to me to lie in the fact that in dead tissues, in such places, therefore, wherein the influence of the living cells upon the bacilli is completely excluded, when a lively growth of the bacilli takes place, they arrange themselves in typically formed groups which resemble the peculiar forms of the bacteria colonies in reinculturen of the same on blood serum. We must therefore consider these forms to be those taken by tuberculous bacilli when developing undisturbed and when their grouping is decided only by the variations and changes of place conditioned by their growth. Every other arrangement is to be looked upon as the working of some sort of disturbance, for example, that caused by currents in the liquids, or by the direct influence of movable tissue elements. So the relative positions of the bacilli in the giant cells, especially their position as opposed to the nucleus, and the radiating arrangement appear to me to be conditioned upon currents in the plasma of the cell, and not by motion belonging to the bacilli themselves, since the bacilli after the death of the cells do not change the radiating arrangement once taken. After the wandering cell which transported the bacillus has changed itself into an epithelioid cell and given up moving from place to place, the path-

ogenic influence of the bacilli prepares to spread itself out upon the neighboring cells existing within a certain circuit. Whether they have proceeded from cells already present in this place in consequence of the attraction exercised by the bacillus itself, or rather by the materials produced by it and diffused into the surroundings, all cells situated within a definite region change into epithelioid cells. The cell containing the bacillus suffers still greater changes. It grows constantly larger, while at the same time the nuclei constantly increase, and it finally attains the shape and size of the familiar giant cells. That the development of the giant cells really goes on in this manner can be seen from suitably prepared sections, which show all stages of development from simple epithelioid cells with one bacillus to the completely developed giant cell with many nuclei and many bacilli. As most suitable for the study of the development of giant cells I should consider the tuberculous tissue of cattle and horses, which is especially rich in giant cells and in which I have often seen the above mentioned transitional forms. The further fate of the giant cells is a varied one, according as the progress of the disease is rapid or slow. In the last case the number of bacilli enclosed by a giant cell is always a limited one. Usually there are only one or two. It is indeed scarcely to be thought that the bacillus found in a large giant cell is the same which caused the formation of the cell. One finds not infrequently in a giant cell a bacillus which is no longer so intensely colored as other bacilli in neighboring gigantic cells; I have also seen cases in which the giant cell contains a dark and strongly colored bacillus, and beside it a second, very pale one, which without careful attention would be overlooked. Furthermore I have sometimes found spore-bearing bacilli in the interior of giant cells. From all this I conclude that the giant cell is quite a durable formation, that the bacilli, on the contrary, do not possess such duration of life, and that they can only maintain themselves for a considerable time in giant cells, in that a new generation follows a dying one. Sometimes they form spores in the interior of the giant cells, and in this case leave behind them the germs of a later generation. But often enough the vegetation of the bacilli in the cell appears to die out and the empty cell then remains as a monument of their former presence. When one, as is often the case in a tuberculous tissue, finds quite numerous giant cells, and among them only comparatively few supplied with bacilli, one can then take for granted that many of the apparently empty gigantic cells contain spores of tnberculous bacilli; others, on the contrary, mark the places of former vegetations of bacilli, and one is tempted to institute a comparison with a volcanic region in which occur not only single active volcanoes, but a great number slumbering for a time, or completely extinct, these latter nevertheless bearing unmistakable marks of their former activity.

As to the fate of giant cells when the bacilli in them increases rapidly, we have already spoken. In this case the result is exactly opposed to the one just described; the giant cell is the conquered party; it is, as it were, burst by the tuberculous bacilli forcing themselves through the wall of nuclei. Its nuclei perish, dissolve themselves into little grains, and the cell perishes.

How it is that at one time the bacilli are conquered, or for a long time remain confined to definite spots and barely hold their own, that at another time their number increases rapidly and all cell elements in their neighborhood quickly

perish, only suppositions can be made, which cannot here be entered upon, but which I will discuss later.

The further changes which complete themselves in tuberculous tissue after the formation of the epithelioid and giant cells are all of a regressive nature. For the greater part they belong in the sphere of the processes described by Weigert as necrosis of coagulation, and lead to the death or the tuberculously diseased tissue and to the formation of the so-called caseous masses which so frequently form the interior of the tuberculous herds. The tuberculous bacilli usually vanish very quickly in the caseous masses, so that they are only to be met in younger herds, and are almost always wanting in older ones. In other cases after the vanishing of the bacilli vegetation, the tuberculous tissue may simply shrink and be changed into firm cellular tissue.

A very important property of the tuberculous bacilli must be mentioned here. It is the spore-forming property. As is well known, F. Cohn was the first to observe in the so-called hay-bacilli the appearance of shining little bodies which remained when the bacilli perished, had the power of germinating and growing to bacilli, and were to be considered the fruit form of the bacilli, receiving hence from F. Cohn the name of spores.

The appearance of the spore formation as it shows itself microscopically in bacilli tinged with aniline colors, is to be seen in a very instructive manner on photograph No. 76, Plate 13, in the first volume of these communications. The bacilli appear there with short joints, and mostly consisting of two joints. Some of these joints are evenly dark colored and still resemble completely the spore-free bacilli on photograph 75.

In many joints one notices, nevertheless, the appearance of a light point which increases in size gradually, while the colored contents of the joint withdraw more and more to the two ends, and the sides are bordered by fine lines marking the outlines of the joint. The bright space in the interior of the bacillus joint is the spore which in this specimen shows itself not by its brilliancy, since it is imbedded in a strongly light-refracting substance, but only by the absence of coloring material. With few exceptions the bacilli spores do not take the aniline coloring. The division into the articulation does not always appear so sharply defined as in the bacilli of this picture.

In many sorts of bacilli, as for example in those belonging to inflammation-of-the-spleen, the members appear closely joined together and form a continuous thread which contains the uncolored spores at regular intervals. The spore formation of the tuberculous bacilli conducts itself in like fashion. The bacillus preserves its connection and does not fall apart into separate joints, but a bright body appears in every joint so that the bacillus after coloring resembles a little dark thread interrupted by bright egg-shaped spaces. By the use of the strongest systems and great magnifying power it may then be shown that the spore-bearing tuberculous bacillus presents exactly the same appearance as the spore-bearing bacilli of inflammation-of-the-spleen, only in greatly diminished proportions. The spores are egg-shaped, bounded by a delicate colored line, and are present usually in the number of two to six in one bacillus. Since every single spore takes possession of one joint, from their numbers we can decide upon the number of the joints of the bacillus, that is to say of the single elements out

of which the same is formed. If a substance containing spore-bearing tubercu-lous bacilli be examined in the uncolored condition and in less strongly refractive liquids, the bacilli appear to be provided with brilliantly shining little bodies; these last can therefore not be vacuoles or simple gaps in the protoplasm of the bacillus, but must be genuine spores.

After these remarks as to the universal qualities of tuberculous bacilli, I now turn to the description of their action in the various tuberculous processes.

A. TUBERCULOSIS IN MAN.

I.—Miliary Tuberculosis.

Nineteen cases in all were examined in which the tubercles were found in the form of miliary and sub-miliary little grey knots, mostly provided with a whitish or weak yellowish centre, scattered in several organs, lungs, brain, liver, spleen and kidneys. The bacilli were wanting in the tuberculous knots in no one of these cases. The smaller and younger the knots were, so much the more plentiful were the bacilli, and they were thickest at the centre. As soon as the middle of the little knot will no longer take nucleus coloring, as soon, therefore, as the caseous degeneration begins, the number of bacilli decreases immediately. In the larger knots, whose centres had already experienced a far-reaching caseous change, few bacilli were to be found, and those only to be found between the nuclei of the epithelioid cells occurring in the periphery of the knot. Now and then one finds in the giant cells occurring on the border of the caseous herd, single bacilli or groups of the same. A noticeable feature which re-appears in the chronic processes of the lungs is this, that most giant cells contain black pigment grains beside which the bacilli are still easily to be distinguished. In other organs I have not seen such pigment-bearing giant cells, and their presence appears to be limited to the lungs. From the analogy of other results obtained from the lungs of swine and other animals, to be mentioned later, I might suppose that we here have before us giant cells which originally developed in the interior of an alveolus and took into themselves the pigment of the perishing cells present in the alveolus. This view is taken by Watson Cheyne on the ground of direct observations of giant cells which were found in alveoli of the human lung. (See Practitioner, April, 1883). These cells, which first developed in the alveoli next to the little knots, are afterwards taken up by them as the knots extend. In many of the older knots the bacilli appear to have vanished completely. Nevertheless, we must remember that the prepared sections of the larger tubercles always contain only fragments, and that if the bacilli are wanting their absence from the whole knot is not thereby proved. The relations here are similar to those formerly described in regard to the giant cells, that is to say, that beside those knots which still contain abundant bacilli others occur in which the bacilli have either entirely vanished or have left spores behind them. Nevertheless, if a sufficient number of sections are examined, one almost always finds spots rich in bacilli, and it would not be right from the results of a few specimens to give a judgment as to the presence or absence of bacilli in miliary tubercles.

In miliary tuberculosis of the liver and spleen, I have seen bacilli almost exclusively in the giant cells. Especially in the spleen, beside completely developed

tubercles, there are often found giant cells of considerable size, which are almost isolated or only surrounded by a few epithelioid cells, and are regularly the seat of one to three tuberculous bacilli.

The tubercles of the membrane of the brain were, almost without exception, rich in tuberculous bacilli. Frequently the latter are found in the immediate neighborhood of small arteries beside which are spindle-formed heaps of epithelioid cells; between the latter the bacilli are strewn in quite uniform numbers. But in many places the bacilli are present in such thick masses that their presence makes itself known, under a weak magnifying power through the blue color of the parts in question. In this case they are principally round cells, therefore younger cell formations, among which the bacilli vegetation has its seat. Sometimes also I have seen bacilli in the interior of the vasa.

Of miliary tubercles of the choroidee only one case was at my disposal, and that I owe to Prof. Weigert. Here also were formed herds without nuclei, (that is to say already developed caseous degeneration), which were surrounded by large giant cells, and many epithelioid cells. Partly in the giant cells, but also partly outside of them, between the epithelioid cells, a good many tuberculous bacilli were present.

With the exception of one case, comparatively old caseous herds were always to be found, especially in the lungs and bronchial glands. Also in these herds, which may be considerd the point of departure for miliary tuberculosis, the presence of bacilli were proved in the cases which were examined with reference to them. Often, to be sure, they were only found sparsely in the periphery of the herd, but sometimes one discovered nests of dense masses of bacilli.

It would lead too far if I should here describe particularly all the cases of miliary tuberculosis which I have examined, and I select, therefore, only some of the most characteristic.

1.—Workman, thirty-six years old. Strong man, who had not felt unwell until fourteen days before being taken to the hospital, attacked with coughing; pains in the chest and moderate fever. The symptoms observed in the hospital were only slightly characteristic, and corresponded with those of catarrhal pneumonia. Under increase of dyspnœ the patient's powers sank rapidly and he died four days after his reception into the hospital. In the journal of dissection the following is worthy of mention. The pleura on both sides occupied by numerous little miliary knots. Both lungs infiltrated, greyish-red, and many little miliary grey knots present; the larger knots show caseous degeneration. In the conus arteriosus of the heart several sub-miliary grey knots of the endocard. On the closing border of the mitralis eruption of firm knots varying from miliary to the size of a pea. In the liver not very numerous little knots. Both kidneys contain grey little miliary knots in the pithy substance as well as in the outer coating in abundance. The hollow of the right kidney dilated, and in the same two defecti with indented borders and caseous base whose diameter is about 1½ to 2 cm. A caseous deposit of the size of a hazel nut in one papilla. Bladder free from tubercles. In the prostata some caseous deposits. In the urethra abundant little miliary knots. Caseous degeneration of the accessory testicles, partly with caseous softening, drawn in scars on the scrotum. In the testicles themselves abundant deposits of little grey miliary knots. The thoracic duct

dilated, on several spots on its wall caseous thickening, and on the inner surface of the same some defecti provided with caseous base.

Here we had a case of chronic tuberculosis of the uro-genital organs. The tuberculosis of the thoracic duct connected itself with this and had as a consequence, the breaking out of the general miliary tuberculosis. This case according to its origin belongs to the form of miliary tuberculosis described by Ponfick and forms a typical example of the same. The microscopic returns corresponded exactly with the description of the action of the bacilli as previously sketched. The tubercles in the lung tissue showed themselves comparatively small, and for the most part contained bacilli in abundance. Some contained so many that under a weak magnifying power a bluish color showed itself in the middle.

Many gigantic cells were also found in the tubercles of the liver and spleen, which for the most part were supplied with bacilli. Very numerous bacilli were present on the edge and in the surroundings of the herd in the papilla of the kidneys. At single points in the surroundings of this herd, the bacilli had collected in groups in the urethra, and the peculiar grouping here manifest suggested the figures which they take in blood serum culturen, and which are to be mentioned later. Whether the bacilli in this case reached the urethra via the course of the blood or whether they spread from the neighboring tissue, could not be decided. In another tuberculous kidney which I received from Prof. Weigert, numerous glomeruli and the neighboring urethra were covered with masses of bacilli, which leads us to conclude that the bacilli can make their way from the course of the blood into the urethra and from there perhaps into the urine.

2.—A second case of tuberculosis of the thoracic duct in a man forty-eight years old shows an analogous behavior. The tuberculous process had been here spread from the caseous mediastinal glands to the thoracic duct, and has brought about miliary tuberculosis of the lungs, liver, spleen and kidneys. Death followed later than in the first case; the tuberculous eruption was not so abundant, the single knots reached a greater size, were more caseous and contained a correspondingly smaller number of bacilli.

3.—Nine year old boy. Said to have been taken sick only a few days before his admission into the hospital. At his entrance into the hospital diseased sensorium, great restlessness and delirium with high fever. In the following days bronchial phenomena showed themselves, death ten days later. Dissection showed: caseous swelling of the bronchial glands; broncho-pneumonia herds in both lower lobes of the lung. Besides these, numerous grey miliary and submiliary tubercles in the lungs, in the enlarged spleen, in the liver and in the kidneys. At the base of the brain, and in the surrounding of the vessels a slight muddiness (trübung) and a great number of little grey knots.

In the tubercles of the lungs, liver and kidneys and spleen, bacilli were found in varying abundance. The tubercles of the pia mater were very abundantly supplied with them.

In the caseous bronchial glands belonging to this case, large quantities of bacilli were found, and not only on the borders of the caseous herd, but forcing themselves far into it. The parts of the gland tissue which were not yet necrotized contained numerous gigantic cells which were noticeable for the multitude of enclosed tuberculous bacilli, and for the radiate arrangement of the same.

Plainly the tuberculous process in the bronchial glands had only lately began and had spread rapidly. The gland tissue had become very quickly necrotized and softened under the influence of the tuberculous bacilli. Somewhere there must have been a breaking through into a vasalumen (gefässlumen) and so considerable numbers of bacilli have got into the course of the blood to have caused the general eruption of miliary tubercles. The location of this breach was, however, not to be found in this case. That the same is not always easy to find may be seen from the following case.

4.—A strong man of about thirty years died after a sickness which showed typhoid symptoms and had not lasted longer than three weeks. From the dissection it appeared that there were very many grey little miliary knots in the lungs, liver and kidneys, as well as in the greatly enlarged spleen. The bronchial glands were swollen, of a marrow-like nature, but not caseous. Also, moreover, no older caseous herd could be proved, in spite of the most thorough investigation, so that one was loth to make a diagnosis of miliary tuberculosis. The intestines and mesenterial glands were not changed.

Microscopic investigation gave the following very noteworthy result: Sections from the bronchial glands showed wide-spread spots bare of nuclei, and which were only filled with black pigment grains, and numerous fragments of perished nuclei, together with dense swarms of tuberculous bacilli. These last were heaped together in such masses in the immediate neighborhood of little arteries that the vasalumen (gefässlumen) appeared to be surrounded by a blue court, even under a slight magnifying power. A greater magnifying power showed these blue masses to be composed of bacilli. In single places the bacilli forced themselves even into the interior of the vasa, and there could be no doubt, therefore, that they found their way into the blood in this manner, and were transported in all directions in great quantity. A third method was thereby sought by which a general tuberculous infection and the miliary tuberculosis conditioned upon it could take place, after Ponfick had succeeded in discovering one of these ways in the thoracic duct, and after Weigert had taught the second, and to all appearance by far the most frequent, in the breaking through of tuberculous masses into the veins.

The miliary tubercles of the spleen and lungs contained a good many bacilli, partly also in the giant cells.

But this case was of great interest in another way. It appeared, namely, that numerous capillaries were filled for short distances with micrococci. Under the double coloring treatment, the tuberculous bacilli took, as they always do, the blue coloring, the micrococci, on the contrary, the brown color. In many places in the same field of vision, and at slight distances from each other, brown colored micrococci and blue colored bacilli were to be seen. The capillary micrococci embolism were moreover very numerous in the lungs, and especially in the spleen. They had not as yet led to striking changes in their surroundings, such as heaping together of nuclei or necrosis, and must therefore have appeared not many days before death. The combination of a bacilli and a micrococci invasion as it occurred here, belongs to the mixed infections whose appearance seems not to be rare. Such mixed infections can be generated artificially in animals by simultaneous or closely following inoculation with various infectious

materials, for example, by using inflammation-of-the-spleen and scepticæmic bacilli in the case of mice. Also tuberculosis and inflammation-of-the-spleen can exist simultaneously in the same animal. I have inoculated a number of guinea pigs which were tuberculous to a great degree with inflammation-of-the-spleen bacilli. In consequence of this, the animals were attacked with inflammation of the spleen and died. Several of them had very large numbers of tuberculous bacilli in the lungs and spleen, and in sections from these, by double coloring, the tuberculous bacilli took the blue, and the very numerous inflammation-of-the-spleen bacilli took the brown color. As a further instance of a spontaneously arising mixed infection, the occurrence of micrococci herds in typhus is to be noticed. Further, Brieger and Ehrlich* have drawn attention to a combination of typhus with malignant œdema, in which case the very fitting expression mixed infection was first used. It is therefore plain that we have such a mixed infection in the case here spoken of. The tuberculous disease of the bronchial glands formed the primary infection, which, in consequence of the rapid growth of the bacilli and their forcing themselves into the arteries, led to general miliary tuberculosis. Not until this disease was well established, the strength of the organism had been very much lowered, and therewith probably the ground for the micrococci invasion had been prepared, did the latter follow; proceeding to all appearance from an ulcerated defekt (imperfection) on the tongue, and causing in connection with the miliary tuberculosis, death so much the more quickly.

A similar combination of tuberculous bacilli in the miliary tubercles of the lungs, and micrococci in the neighboring vessels, has been observed by Watson Cheyne, † and it may therefore probably be accepted that with a little attention this sort of mixed infection might be not infrequently found.

Of the other case of miliary tuberculosis coming under examination, the folowing may be briefly sketched:

* Berl. klin. Wochenschrift 1882. No. 44.
†The Practitioner, Vol. XXX. No. 4, Apr., 1883, p. 295.

(*To be continued.*)

RECORDING CLINICAL OBSERVATIONS.

By Prof. A. Liautard, M.D., V.M.

A Paper read before the United States Veterinary Medical Association.

Mr. President and Gentlemen:

Not long since, in reading an English veterinary paper named the *Veterinary Record*, my attention was attracted to a paragraph heading an article of that excellent hebdomadary, which I thought contained a suggestion of great value, and which it seems to me all veterinarians and especially, perhaps, those of America, might

do well to have printed in large letters in their studios as a memorandum of their duties to themselves, to their colleagues and to their profession. The paragraph reads as follows:

"*Careful observation makes a skillful practitioner, but his skill dies with him. By recording his observations, he adds to the knowledge of his profession, and assists by his facts in building up the solid edifice of pathological science.*"

How true those words are, and how powerful their meaning!

Deprived, as the veterinarian is, of many of the means of diagnosis of which the human practitioner may take advantage, how important it is for him to be able to refer to the works and the positive observations of his predecessors, to be able to recognize diseases, to be certain of pathological changes and correctly to direct his therapeutics. Indeed the question might be asked, what has made our pathology of domesticated animals in its various forms, whether equine, bovine, ovine, porcine and canine—how have our predecessors, from the works of olden times, to our recent and modern authors, been able to lay down the etiology, symptomatology, pathology and therapeutics by which to-day all of us and the veterinarians of the future are going to be able to fulfill the duties so variously assigned as physicians, surgeon, obstetrician, therapeutist or sanitarian.

The answer to these questions is a simple one; it is that in those days, "careful observers had become skillful practitioners, and that, not to die with their skill, they had recorded their observations to add to the knowledge of their profession and assist in building the solid edifice of pathological science."

But is our patholgy yet perfect? Is our knowledge as positive as it should or might be? Can we boast that the symptoms of ALL diseases are mastered by us? Are we not liable to make, and do we not often make errors of diagnosis? Are there not, among the numerous disease to which animals are subject, still many of which we know so little that our medical knowledge remains unable to detect them, or to cure, or even sometimes to relieve them?

If these queries are suggestive of facts, what are our obligations, and does it not become a duty that imposes itself upon

each of us as simple individuals, toward our colleagues and toward our profession and its noble calling, to make a written record of the result of our observations, that we may thereby make ourselves live for ever—so to speak? By doing so we help our brethren in the profession in the performance of their duties, and by it we build up the most perfect and solid edifice of pathological animal science.

If these remark are proper, gentlemen, I hope you will grant me a little more of your attention in suggesting briefly the rules which I believe ought to be observed in the redaction of clinical observations.

The writing of reports constitutes the minute-history of diseases. They are documents that ought to be specially correct, and gathered in a regular manner, and I might say always with the same method, to allow ulterior researches. The report of a case might be divided into five sections, viz: the description of the patient; the history of the case; his condition when called to attend to him; including the diagnosis, the prognosis, the treatment, the result, and his cause of death through the post-mortem.

The description of the patient we believe ought to be as complete as possible. The color, sex, age, breed, aptitude to special work and general constitution, are all more or less important points; some affections being more common in various animals, and almost specific to them, more than in others, and this is in many instances due to the very peculiarities mentioned in that description. If, for instance, stallions are more commonly affected with hernia, young animals are more subject to peculiar forms of infectious diseases than old ones; light-colored animals suffer more with pigmentary affections than dark ones; lymphatic animals are more liable to blood diseases than nervous individuals; saddle horses will be exposed to bruises which are seldom met with in heavy draught animals, and weak, debilitated animals will be more exposed to diseases in general than strong and robust ones.

The history of the patient, or the "*commemoratives*" is of the greatest importance, and yet it is not always fully appreciated by veterinarians. How many times have we witnessed an attempt

to make a diagnosis without a history of the patient, and how can this be accomplished with positiveness, is yet a problem to me. Truly, a practitioner may indeed, after years and years of close observation and labor, be able to express an opinion upon the nature of a case, and be correct in it, but still errors must often occur.

I don't ignore the fact that the alleged history is often an imperfect one, and perhaps misleading, but with all that, I believe no one is justified in overlooking its value. The manner of obtaining the history of a patient may be divided in two parts—first the interrogation of the owner and that of the patient himself. Questioning the owner is almost an art, which though at first may seem simple and easy, yet requires tact and practice, and close attention to be of value. The questions must be made and repeated at variance, to obtain clues to the truth, since often, for reasons that cannot be discovered, the answers are deficient and erroneous, if not untruthful, and too often they are intentionally given in a way to mislead the deductions of the closely attentive inquirer.

To illustrate the importance of this point, I can only mention the case of a horse being brought to my observation some twenty years ago, with the simple history that could be obtained, that the animal could not eat, and in which a simple diagnosis of simple sore throat was about to be made, when by chance a dog passing within his reach, the horse sprang towards him with rage. Surprised by this action, I inquired of the owner if the horse had ever been bitten by a mad dog, and then he remembered that some time before a strange dog had entered his stall and bitten him, and that in being brought to me he had several times, when meeting dogs, attempted to rush at them and take hold of them. This part of the history was sufficient, and too characteristic to allow a doubt as to the nature of the disease. The poor horse succumbed a few days later to an attack of the most violent rabies I have ever seen.

The interrogation of the patient is no less important, and is a task often difficult to perform. Unable to obtain from the sick animal by words the answers necessary, the veterinarian must

consult his motions, his aspect, often his desires, and often from nothing, make his conclusions. Everything must be carefully weighed and considered without partiality or pre-conceived idea.

The condition of the patient forms a very important part of the record, for it is that condition that will help the practitioner to justify the diagnosis he may make, help others to recognize the same disease, and help the making of a correct veterinary pathology.

The description of the symptoms may be considered as of those which may be called specific and those which affect the entire organism, and are of a general character. An alteration in the function of respiration as characterized by an increased dilation of the nostrils; an acceleration of motion at the hypochondriac region or at the flanks; changes in auscultation and in percussion; peculiar forms of coughing—all these may be considered as specific symptoms of lung diseases. The general symptoms are those that are offered by the changes found in other functions, such as the condition of the circulation, as indicated by the pulse and appearance of the mucous membrane; the condition of the digestion by the appetite; the state of the abdomen by the aspect of the fæces; the condition of the nervous centers by the more or less marked diminution of the strength of the animal, and a general febrile condition by the registered heat of the thermometer.

These general symptoms ought not to be neglected, and in mentioning them I do it because I am afraid many of our young practitioners and recent graduates may be too apt to overlook their value.

When these are well obtained and recorded, and not until then is the practitioner ready to make his diagnosis, that is to specify its nature and its seat. Truly this will then, in many instances, be easy to make, but often, also, it will be sufficiently difficult, and it is then, when the answers to all these observations remain obscure, that still more their importance presents itself and becomes emphasized.

To prognosticate, in its etymological acceptation, means to

presume. Therefore, the prognosis becomes the presumption of what will take place. In some circumstances it is easy to predict the result, as suppurative pneumonia generally terminates by death; but in other circumstances the presumption is subject to many circumstances, and in that case the prognosis is guarded.

The fourth chapter of a report is to be considered under two headings. First, that of a surgical; second, that of a pathological case. If of the former kind, a minute description of the surgical manifestation is always indicated, and especially so during the operation, if complications, accidents or abnormal structures are met with. When this is done the case is recorded as in the second heading, that of a pathological case, that is, an exact and concise daily description of the condition of the patient while under treatment, with the results obtained, changes observed, modification prescribed in the therapeutics formerly used—and then comes the fifth chapter.

Recovery or death. The last ought always to mean a post-mortem. The examination of cadavers is most essential. It is by this that the true causes of death are found.

The cadaver is then a book, in which the described diseased process can be read, and where every organ represents as many pages, on which are written the pathological lesions resulting from it. It is in many cases a confirmation of a diagnosis and a gratification to the practitioner. But if the diagnosis is disproved by the post-mortem, a much greater amount of valuable information is obtained, and a most beneficial teaching secured. Post-mortems ought to be carefully made, and above all most minutely recorded.

Some time ago, in an editorial note in the AMERICAN VETERINARY REVIEW, relating to an excellent article of our friend Dr. Clement, I called the attention of my readers to the record of three reports of post-mortems, which he had made, and which he published as an example of the manner in which this work ought to be done. I will not take any more of your time by reading these, but will strongly urge you to read them in the Reference Hand-book of Medical Science.

MEDIATE CONTAGION.

ANSWER BY DR. GADSDEN.

A Letter read before the United States Veterinary Medical Association.

My Dear Doctor:

Your kind favor of the 4th inst., containing an invitation to attend and address the annual meeting of the United States Veterinary Medical Association, on the subject of "Mediate Contagion" in contagious pleuro-pneumonia, was received at my house during my absence from the city, and was forwarded to Longport, and failing to reach me there was returned to Philadelphia, where I received it yesterday. I regret very much that the invitation came to me so late that I will be prevented from accepting it by other engagements which I had made before receiving it, and the shortness of the time will prevent my writing anything on the subject further than to reiterate the views expressed in my former paper, a copy of which I will mail you on my return to the city to-morrow, together with any new facts I may be able to gather in the brief time before your meeting.

It was a long time before some of our professional brethren could be convinced of the truth of the theory which I held, that the disease was spread by the chronic or so-called recovered cases, but even our friend Dr. Salmon I think will now admit, after the careful experiments he has made, that this theory is correct. And I feel assured that it is but a question of time when he and the others who now hold to the contrary opinion will be convinced, if they will devote the same care to experimenting, that the disease can only be communicated by contact with the living diseased animal. Now by contact I don't mean an actual *rubbing* together of the diseased and healthy animals, as would seem to be implied by Prof. Law in his rejoinder, but their confinement together in the same building or small enclosure, where the germs exhaled in the breath of the diseased animal can be inhaled by the healthy ones. For I am thoroughly convinced that after the death of the animal any germs that may have been contained in its carcass lose vitality, and the power to infect the

lungs of a healthy animal. While it is true that the serum from a diseased lung can, after being carried a long distance and kept for a considerable time, be introduced into the tail of a healthy animal, and produce inflammation and febrile symptons, yet a post-mortem would fail to show the slightest trace of the characteristic lesions of pleuro-pneumonia in the lungs.

I am equally convinced that no infecting power remains in any germs that may have found lodgment in litter or refuse or in any portion of the stable or buildings, and cannot see the slightest necessity for ordering the destruction of buildings, or compelling them to remain empty for weeks or months, except to entail unnecessary loss and expense upon the unfortunates who have had diseased animals and got rid of them.

While as a matter of cleanliness and for the purification of the atmosphere of a stable, the use of lime and other disinfectants is not at all objectionable, yet I do not believe it necessary, if all the diseased animals and those that have been in contact with them have been entirely removed, and the stable refilled with perfectly healthy animals among which are no "recovered cases;" for these latter have been the means of spreading the disease in many instances; where not suspected themselves, they have infected healthy animals, and the litter or buildings got the credit for it. Kill all chronic cases and animals that are diseased or have been in contact with diseased animals and you need have no fear of inanimate objects as mediums of contagion.

BIBLIOGRAPHY.

ROARING IN HORSES—LARYNGISMUS PARALYTICUS. By George Fleming, C.B., LL.D., F.R.C.V.S., etc. Bailliere, Tindall & Cox, William Street, Strand, London.

This is an excellent little work of one hundred and sixty pages, handsomely illustrated, for which his professional brethren are indebted to that indefatigable observer and author, George Fleming. The disease of roaring, with its surgical treatment, has for some time engaged the attention of English veterinarians, among whom it has become a subject of much controversy. The

publication of the first report of the discovery of a new surgical treatment for this affection, and the announcement of the success which had followed its application, at once excited public attention, and a large amount of criticism found its way into the veterinary press, many of the writers expressing their doubts, and a portion of them their entire dissent in regard to the correctness of the published reports. Experimental tests were made by various practitioners, and the occurrence of failures in these numerous cases seemed to confirm the negative verdict upon which the dissenters had agreed. We were ourselves included in this class. Misled by errors of statements contained in the early reports, the experiments failed to be successful in consequence of the improper operations which had been described, or rather, because those which were performed were not identical with those which Dr. Fleming had described in his "Roaring in Horses." It seems that the conclusions were too hastily adopted, just as the experiments had been too hastily made. They were, in fact, made on false interpretations of the *modus operandi* required for the relief of this serious disease.

In this little book the author does not limit himself to a mere description of the operation, but adds to it an excellent and most complete treatise upon the affection, the treatment of which has hitherto baffled the skill of veterinarians.

In a series of chapters, the reader is fully interested in the history and the etiology of the disease, with its various predispositions, and symptoms and pathological anatomy, and is then inducted into the various forms of preventive and curative treatment, the concluding portion consisting of a minute description of the true surgical steps of the process, from which the prevailing sensation has risen, and which has resulted in the controversy which has been so vigorously maintained. The literary execution of the work has been performed with the characteristic ability of the author, and is marked by the same clearness of statement and easy and graceful style of composition which those who are familiar with the writings of the author have learned to expect from the practised pen of Dr. Fleming.

A number of well executed plates illustrate the work, and

cannot fail to assist the interested reader in following the carefully prepared text. The book is a valuable one, and its publication cannot fail to add largely to the well won reputation of the author. It doubtless will, as it ought to be, thoroughly appreciated by all English-speaking practitioners, if for no other reason than its agency in correcting, as it does, existing erroneous impressions, by furnishing to the profession a conclusive and satisfying answer to those who would now charge upon veterinary science the existence of an uncured roarer as an opprobrium which it is unable to throw off.

PHYSIOLOGY OF THE DOMESTIC ANIMALS. By Robert Meade Smith, A.M., M.D. F. A. Davis, Philadelphia.

Taking into consideration the progress which comparative medicine has accomplished within the past few years, and especially that which involves the department of veterinary science, and considering, moreover, the number of the works which have enriched the bibliography of English veterinary literature, is it not a remarkable fact that while all other branches of this science have been more or less fully treated, one of them, indeed one of the principal, and as important and essential as any of the preliminary studies which are introductory to all the others, that of physiology, to wit, should alone have been ignored? For years veterinary schools have been established and in progress in England, Canada and the United States, with hundreds of students crowding their halls, and hundreds have been graduated who were supposed to have studied veterinary physiology, yet how have they been able to do so? In fact they have been obliged to learn the physiology of the horse by studying that of the human animal. It is true that there is a great deal of similarity and sometimes somewhat of identity in the execution of the various functions of the body in all animals, but there are likewise great and important differences, and the student who has not acquired a knowledge of foreign tongues, and cannot study the works of French or German authors in the original, can never be without a disappointing sense of his inability to educate himself in his profession as thoroughly as he might and ought to desire. Veterinary

physiology in English has thus long been a desideratum in our schools. Dr. Robert Meade Smith has, however, now amply filled the want so long felt, and has done it in as proper a manner as the most exacting of critics could demand.

His work of over nine hundred pages is divided into three parts. In the first, the general physiology of cells is extensively treated, under three sections, including respectively, their structure, physics and chemistry. The second part introduces the important subjects of food, the functions of digestion being minutely described, and the process of rumination receiving careful attention, and following this come in their order the phenomena of the circulation and respiration, with the various secretions, mammary, renal and cutaneous, and in time the subject of general nutrition, and the physiology of motion, to the veterinarian perhaps the most important of all, and then succeeds the physiology of the nervous system, with that of the various senses, which completes this long and very interesting second part. The third division is entirely appropriated to the function of reproduction.

The general make-up of the work is highly creditable to the publisher. Four hundred illustrations are introduced, and it is altogether a handsome volume. In the preparation of so comprehensive and excellent a work, Dr. Smith has of course been obliged to avail himself largely of the labors of those who have already surveyed the same field, and he does not fail amply to acknowledge the fact. We have, for example, in several places recognized the work of our former teacher, the great Colin, of Alfort, but it would be impossible for this to be otherwise. Dr. Smith has conferred a great benefit upon the veterinary profession by his contribution to their use of a work of immense value, and has provided the American veterinary student with the only means by which he can become properly familiar with the physiology of our domestic animals. Veterinary practitioners and graduates will read it with pleasure. Veterinary students will readily acquire needed knowledge from its pages, and veterinary schools which would be well equipped for the work they aim to perform, cannot ignore it as *their text book* in physiology.

OBITUARY.

JULES C. A. DE FAVEL died of cancer of the liver in San Francisco, California, in the month of March. Graduated at Alfort, France, he occupied a prominent position in the French colony of San Francisco, where he was highly respected for his learning and skill. He held several positions under the United States and had an extensive practice. He died at the age of 58 years.

SOCIETY MEETINGS.

UNITED STATES VETERINARY MEDICAL ASSOCIATION.

The twenty-sixth semi-annual meeting of the United States Veterinary Medical Association was held at Young's Hotel, Boston, March 19th, 1889. Pres. Huidekoper called the meeting to order at 11 A. M.

On roll call the following members responded to their names—Drs. Bailey, Berns, Thos. Bland, Blackwood, Breakell, Bryden, Clement, Cochran, Faust, Flagg, Gill, C. H. Hall, Harrison, Hawk, Hoskins, Howard, Huntington, Huidekoper, Hitchcock, Liautard, Martinet, W. B. E. Miller, L. McLean, R. A. McLean, Mustoe, Osgood, Peters, Peabody, J. L. Robertson, A. A. Rose, Ross, T. B. Rayner, Jos. B. Rayner, J. S. Saunders, R. J. Saunders, J. H. Stickney, Simmonds, Sherman, Tuttle, Winchester, Chas. Winslow, and Zuill. Drs. Russell, of Maine, W. T. Russell, of New Hampshire, and Bronnell, of Massachusetts, were present as applicants for membership.

The minutes of the annual meeting were read and adopted.

The report of the Comitia Minora was then read and adopted, directing a revision of the Constitution and By-Laws.

Drs. Hinckley and Lusson were recommended for membership and afterwards elected.

The application of Dr. Edgar R. Marlin, of Philadelphia, was rejected on the grounds of violation of code of ethics, in holding a contract under Live Stock Insurance Company, to the detriment and injury of his fellow members.

The following resolution offered by Dr. Huidekoper, was adopted:

Whereas—The Comitia Minora find that many of the By-Laws of this Association have been violated, that candidates elected have attended meetings without payment of dues, or signing the constitution; that members have been dropped from the rolls without notice being given to the Association: Therefore,

Resolved—That the committee appointed to revise the Constitution and By-Laws consider if names exist on the rolls of the Association which are not entitled to membership, and report the same at the next meeting.

The recommendation of the Comitia Minora to hold the next annual meeting of the Association in September, in Brooklyn, was adopted.

The Committee on Intelligence and Education, through the Chairman, Dr. Coates, made an interesting report of the various veterinary movements during the preceding six months.

The Chairman, Dr. Liautard, made a brief report of the lack of success of the Committee on Army Legislation.

Under the head of new business Dr. Liautard offered the following resolution:

That this Association shall hereafter hold only one meeting yearly, on the third Tuesday of September, and that the officers of the Association make the necessary arrangements to have said meeting last at least two days. On being seconded it was laid over until the next meeting of the Association.

The afternoon session commenced at 1:30 P. M., when the Chairman asked for the reading of essays.

Dr. Winchester responded with one on the subject of "Tuberculosis," giving in interesting detail the history, mode of development and dangers of the ingestion of food and flesh from these tubercular subjects. In his excellently prepared article he quoted leading authorities abroad and at home, showing the danger and means of transmission from animal to man.

The reading of the paper was followed by remarks from Dr. Miller of New Jersey, showing its prevalence in his State and the rapid increase it was making, with no law or safeguards to delay its progress and dangers.

Its existence in New York State was referred to by Dr. J. Faust, who specially quoted an incident of its rapid destruction of the usefulness of a herd of thoroughbreds, likewise referring to the existence of laws in the seventeenth century against selling the milk or using the flesh, in Germany, and contrasting the absence of such safeguards now.

Dr. Liautard in a few well chosen remarks called for some means of arousing public sentiment to the importance and grave dangers of this disease, and suggested that veterinarians should in their States and respective localities use more freely the channels of the public press, to aid them in at least limiting its prog ress, and lessening its evils.

Dr. L. McLean of Brooklyn, reasoning from the admitted and undoubted facts of its transmission from animal to man, and the reccgnized gravity of the danger by the veterinarian, suggested that if the milk cans from some of the herds infected with tuberculosis were labelled "consumption at eight cents per quart," it would not be putting it too strong, and would probably arouse the people from their state of lethargy. He then painted a word picture of the head of a family afflicted with consumption, to whom only an overcrowded hospital for such cases could be recommended, while the fruitful cause of his sad affliction remained undisturbed and unguarded.

Dr. Peabody of Rhode Island referred to its extensive inroads in his own State, and quoted a case from his own experience of the dire results following the use of milk from an infected cow, where she was selected specially for milk purposes. Also to its development in cats, when fed tubercular meat from animals dying from tuberculosis.

Further remarks were made by Mr. Stockbridge, of the Massachusetts Cattle Commission, verifying many of the statements made by the essayist, and reporting recommendations made by the State on the subject.

The further discussion of the subject was entered in by Mr. Sessions of Massachusetts, and several others, after which a vote of thanks was tendered the essayist.

The President then announced the following Committee on Revision of the Constitution and By-Laws—Dr. Miller of New Jersey, Dr. Goentner of Pennsyl

vania, Dr. Clement of Maryland, Dr. Harger of Pennsylvania and Dr. Robertson of New York, with the President and Secretary members ex-officio.

Dr. Liautard then read an article entitled, "Recording Clinical Observations." It proved to be one of the most suggestive papers read before the Association. The advice and suggestions it contained were fraught with great value to the coming generation of veterinarians, if followed by the present, in building up through the channels of records of clinical cases, a literature for the veterinary world that would broaden and increase its value to an inestimable extent.

After some discussion, Dr. Gadsden's paper on "Mediate Contagion of Contagious Pleuro-Pneumonia," was read by the Secretary, and the discussion of the same was on motion postponed to the annual meeting.

The President called attention to the International Medical Congress to be held in Paris the coming summer, and suggested that credentials of this Association be furnished any members who expect to be in Europe at that period.

The meeting then adjourned to meet in Brooklyn September 17th, '89.

The evening was spent around the banquet table, where forty-three member-partook of the bountiful provision of good things so well prepared by the local Boston Committee, and the day's enjoyable festivities and renewing of fraternal relations were completed by responses to the following toasts:

"The Veterinary Profession in the United States," Prof. A. Liautard. "The Veterinary Profession in Canada," Dr. Bryden. "The Medical Profession," Dr. Ernst. "The Relations of Veterinary Medicine to Sanitary Science," Dr. L. McLean. "Agriculture," Hon. W. R. Sessions. "Relation of the Veterinarian to the Agriculturist," Hon. Levi Stockbridge. "The Press," Dr. Huidekoper. "The Humanitarian part of the Veterinarian," Col. Currier. "The Early Days of the Association," Dr. J. H. Stickney. "The Ladies," Dr. J. Faust, and several other toasts of a more local character by members of the profession.

W. Horace Hoskins, *Secretary.*

PENNSYLVANIA STATE VETERINARY MEDICAL ASSOCIATION.

The annual meeting of the Pennsylvania State Veterinary Medical Association was held at the Veterinary Department of the University of Pennsylvania, on Tuesday, March 5, 1889, at 10 A. M.

President Thomas B. Rayner called the meeting to order, and on roll call the following members responded: Thos. B. Rayner, W. S. Kooker, W. L. Zuill, Goentner, Blank, Hart, Weber, Ridge, Hoskins, J. C. Michener, Keil, Geo. B. Rayner, Custer, Reinhart, Collins, Glass, Jos. B. Rayner, Sallade and Williams; As guests and applicants for membership—Dr. L. McLean of Brooklyn, W. M. Brodhead, W. H. Ridge, Robert Tonnad, R. G. Webster, Chas. Bland, R. A. Hummel, A. Maurise, W. B. Montgomery, A. F. Schrieber, J. S. Butterfield, J. Z. Tintsman, E. D. Bachman, T. W. Corbyn, Jas. Graham, James T. Ross and Connolly.

After reading of minutes of last meeting and approval of the same, the Association proceeded to elect officers for the ensuing year as follows—President, Wm. L. Zuill; First Vice-President, James B. Rayner; Second Vice-President, Chas. T. Goentner; Third Vice-President, J. Curtis Michener; Recording Secretary, S. J. J. Harger; Corresponding Secretary, W. S. Kooker, 457 North 4th

street, Philadelphia; Treasurer, Jno. R. Hart; Board of Trustees—W. Horace Hoskins, J. C. Michener, S. J. J. Harger, C. J. Blank and Alex. Glass.

The following names were favorably passed upon by the Board of Trustees, and elected to membership of the Association—Drs. Tonnad, Broadhead, Ridge, Montgomery, Webster, Ross, Graham, Schrieber, Tintsman, J. S. Butterfield, Maurise and Bachman.

The Committee on Legislation, through its Chairman, reported the condition of the bill before the State Legislature, and though the bill was not in the best shape, it was fully expected to become a law in almost its original shape, as the opposition to the bill was very slight.

Dr. Zuill, Chairman of Committee on Sanitary Science and Police, made an extensive and highly commendable report, suggesting a plan for properly covering the State, and for thorough inspection of meat and milk. His remarks as to the existence of glanders and farcy, the prevalence of tuberculosis and pleuro pneumonia were interesting and commended very highly the work of the Bureau of Animal Industry in this latter disease.

The report of Committee on Intelligence and Education was called for, and the Chairman, Dr. Hoskins, covered the present condition of the profession, and outlined the vast work before the Association and its members in the future in this State.

Under the head of new business, it was decided by a unanimous vote, to publish in pamphlet form the reports of Drs. Zuill and Hoskins for distribution.

The Corresponding Secretary, Dr. W. S. Kooker, referred in suitable terms to the very great aid he had received throughout the whole State from veterinarians in furthering the work of securing legislation.

The meeting then adjourned to lunch, which was prepared by the Keystone Veterinary Medical Association, at which all the members found pleasure in mingling together, and at the same time satisfying the appetite with viands of a very enjoyable character.

The afternoon session was devoted to reading of papers and discussion of the same.

The first paper was on the subject of over-checking, by Dr. Zeno S. Keil. The writer took very strong grounds against this method of reining horses, and criticized severely the results of the same, and the pain and suffering inflicted upon the animals so used.

The next essay was on the subject of cremation by Dr. Jas. W. Sallade. The reading of this most elaborately prepared article was a source of some amusement as to what its practical bearing was upon the veterinary profession, and though a very grave sanitary question among men, the writer failed to bring forth the value of the adoption of the same among the comparative animals.

After seating of the new officers and some other routine work, the meeting adjourned to meet in Pottsville in September.

W. Horace Hoskins, *Secretary.*

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